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WORLD PETROLEUM

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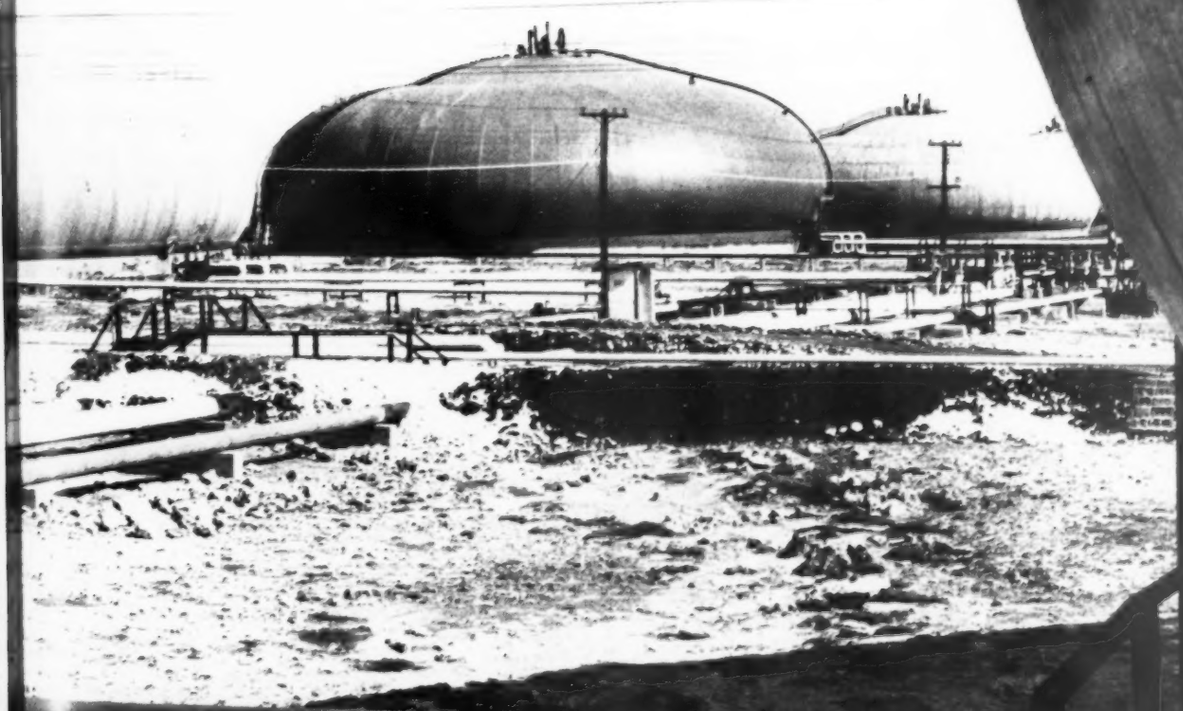

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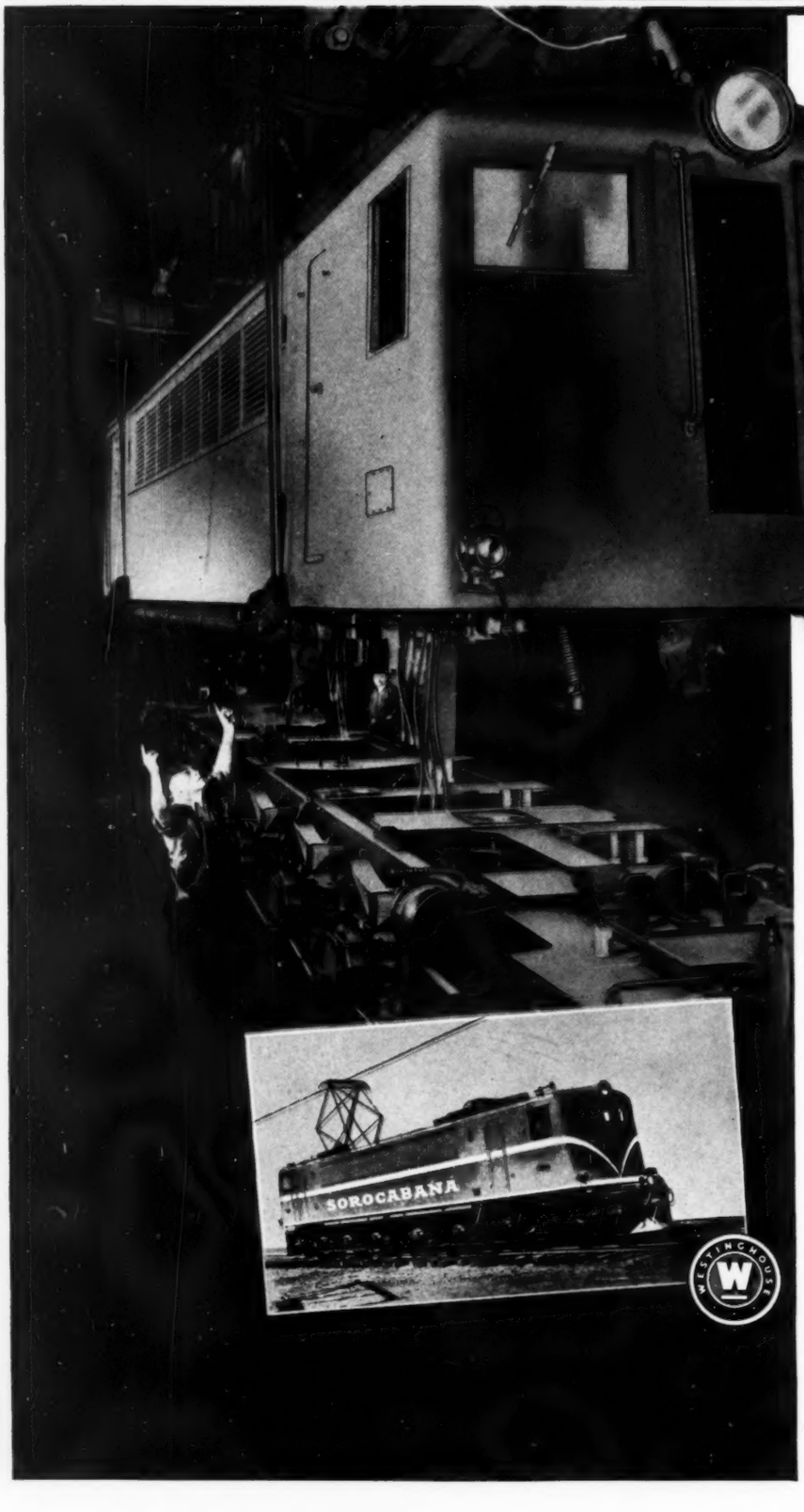

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WORLD PETROLEUM

PUBLISHED BY MONA PALMER

THE MANAGEMENT PUBLICATION OF THE INTERNATIONAL PETROLEUM INDUSTRY

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Photo Courtesy of Standard Oil Co. (N.J.)

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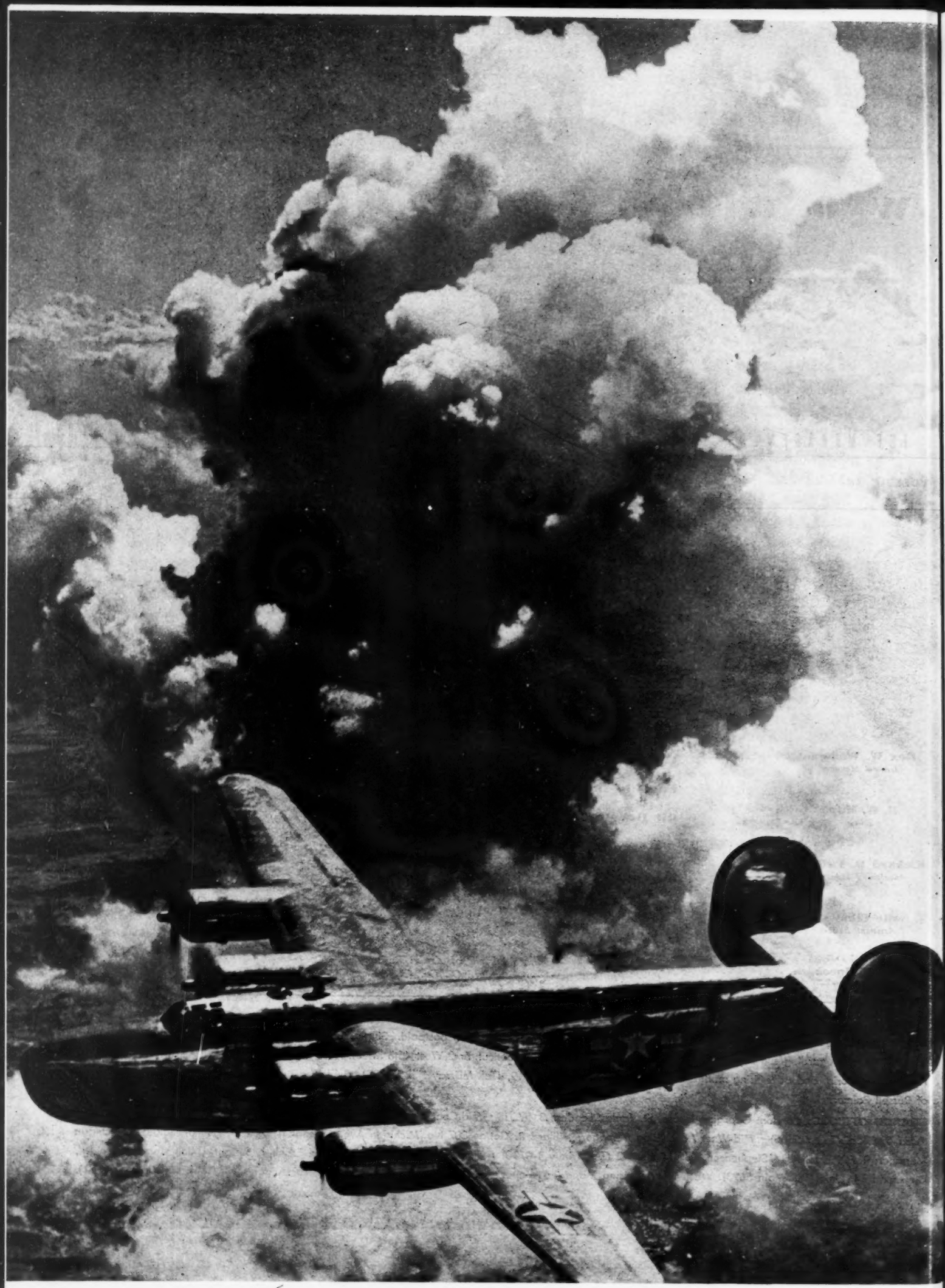

EDITORIAL

WAR'S HEAVIER DEMANDS UPON OIL INDUSTRY

THE change in the military situation at the turn of the year has poised new and difficult problems for the oil industry. It has postponed the time when the industry can begin the readjustment of its operations to something approaching a normal basis for perhaps a year. This does not mean that the final ending of the European conflict has been delayed for twelve months by the Nazi drive into Luxembourg and Belgium. It does mean that the chiefs of staff and of the services of supply have had to make a new evaluation of possible requirements in the way of men and materials and to provide for larger drafts of both. It disposed of the comfortable theory that V-E Day was close at hand and that a diminution of requirements in the Atlantic theatre would take place before operations in the Pacific reached full proportions, thereby making unnecessary an increased effort to provide greater fighting strength and larger output on the production line.

On the contrary, while the struggle in Europe is being protracted beyond earlier expectations, the drive against Japan is moving more swiftly and attaining greater momentum than was anticipated. As a result there has been a reappraisal of requirements, a renewed tightening of restrictions upon the use of materials and a heightening of demands for certain essential products among which petroleum is one of the most important. Talk of reconversion, of liberalized provision of motor fuel for civilians, or of a relaxation of the war emergency control exercised by the federal government, is banished. Instead the oil industry is being called upon to better the impressive record of national service it has established during more than three years of war, to drill more wells, find more production and raise still higher its output of the specialized fuels and lubricants on which success in the conflict so critically depends.

Even before the end of 1944 the oil men of the United States were put on notice that it would be necessary to maintain the production of crude during the current year at the record level of 4,700,000 barrels daily — more than 1,700 million barrels for the year or more than the entire world output no longer ago than 1935. They were asked to drill 27,000 wells — 5,000 wildcats — both figures well above the record of any past year and to do this in the face of a greater stringency of manpower and materials. The problem of transportation which had been met so far as the eastward movement of oil was concerned is now complicated by the rapidly rising requirements of the Pacific campaign and the relative paucity of facilities for movement in that direction.

Refining faces special difficulties under present conditions. The great construction program which multiplied the production of high octane gasoline more than twelvefold in three years was considered to be close to completion at the end of last year. Some of the projects tentatively considered in earlier stages of the program had been dropped because it was not believed that additional capacity would be needed. With military demands rising at a rapid rate it is necessary to provide additional facilities and to increase production by many thousands of barrels daily. This will be accomplished by adding to existing plants new units for which plans already have been drawn or by converting refineries not yet equipped for the production of high test fuel. Time is the important factor in meeting this situation and the engineering skill and genius for construction which have succeeded in meeting every past requirement will be brought into play to accomplish the needed expansion in capacity. This task, in fact, already is moving forward in high gear.

To meet these new and severe requirements will entail serious sacrifices by the oil industry. It will involve the production of many fields above their maximum efficient rate to their ultimate detriment. It will place further emphasis upon the diversion of manufacturing facilities to specialized products for which there will be small demand after the war. It will mean the sacrifice by many companies of resources that are irreplacable. Nevertheless, it is certain that every sacrifice will be gladly made and every demand will be met by an industry that has not failed the nation in any single respect throughout the war.

While the United States heretofore has provided nearly three-quarters of the petroleum products devoted to war use by the United Nations other countries will be able to carry a larger share of the total burden than they have in the past. This should ease the strain upon this nation to some extent or at least should provide a substantial part of the added requirements. Oil from the Caribbean area and the west coast of South America already is moving in substantial quantity to the Pacific area and this volume will be considerably increased as the year advances. Additions to refining capacity in the Middle East will come into operation before the end of the year and will enable this prolific region to contribute more war products to either or both fronts. There is no danger that a lack of oil will hamper the Allied effort but to make that effort effective in the highest degree will require even greater exertion than in past years on the part of the oil industry.

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MAXIMUM RATE OF PRODUCTION MUST BE MAINTAINED IN 1945

By J. R. McWilliams

Director of Production Division
Petroleum Administration for War

Military Demands Plus Domestic Necessities Require Daily Output of 4,700,000 Barrels—More Drilling Called for Despite Manpower and Material Shortages.

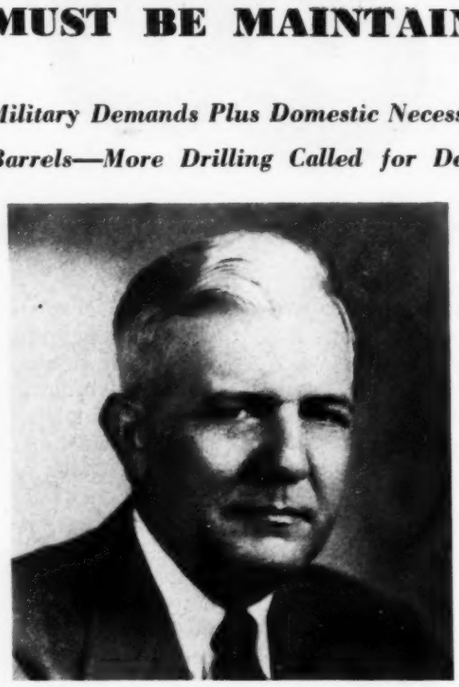
THE petroleum industry is faced with the task of maintaining crude oil production throughout the year 1945 at the present high rate of approximately 4,700,000 barrels a day even though the European war ends within that period. This task will not be easy; our cushion of excess productive capacity has now been virtually absorbed; stocks of crude oil and petroleum products are at minimum working levels, and shortages of materials, facilities, and manpower still exist. It will require a maximum of effort and cooperation on the part of all those on whom rests the war-time task of producing sufficient crude oil to meet fully the military, essential industrial, and minimum civilian requirements for petroleum products.

The year 1944 was one of outstanding achievement from the standpoint of crude oil production, and the industry can justifiably take great pride in the results attained. Nation-wide production of crude oil rose steadily during the first half of the year until July when, for the first time during the war, or for that matter, in the modern history of the industry, total crude output exceeded the maximum efficient rate of production. Thereafter, production continued to rise to a record high of 4,766,000 barrels daily during the month of September, followed by slightly lower levels in the final quarter of the year when production averaged in excess of 4,700,000 barrels a day.

The current daily rate of crude oil production is roughly 1,000,000 barrels higher than production in prewar years and approximately 600,000 barrels above the average daily production of 4,118,000 barrels in 1943. While the production record established in September stands out as the highlight in the year's achievements, the fact that it has been necessary to exceed the nation's maximum efficient crude oil productive capacity since June is a far more significant development, particularly from the standpoint of our ability to meet future war requirements.

At the beginning of the war, the United States fortunately had a substantial volume of excess productive capacity which had been built up during the 15 years preceding the outbreak of hostilities. This excess productive capacity, resulting from highly successful exploration and development operations during those years, has made it possible to meet wartime requirements despite the drastic curtailment in drilling operations necessitated by shortages of steel and other critical materials.

As a result of the greatly increased requirements for oil, coupled with the reduced rate of drilling during the last three years, the cushion of excess productive capacity has now been absorbed. Substantially, all available efficient productive capacity is now being utilized, and in many instances fields are being produced as a matter of war necessity at rates in excess of what is considered efficient practice, with a sacrifice of ultimate production from such fields and, of more immediate importance, at the expense of over-all productive capacity later in the war. Continuation of this harmful practice should be avoided if possible.



J. R. McWilliams

With the knowledge that military requirements will necessitate the maintenance of the present high rates of crude oil production at least throughout the year 1945, it is imperative that our drilling program for the coming year be expanded to offset the rapid decline in productive capacity now being experienced.

It is gratifying to report that the drilling program of 24,000 wells set by the Petroleum Administration for War for the year 1944 was achieved in full. In the preceding two war years, approximately 19,000 wells were completed annually. While the number of exploratory wells drilled in 1944 fell short of the 5,000 wells which were programmed for the year, the total of approximately 3,800 wildcats completed represents a sizable increase over the 3,512 drilled in 1943 and 3,223 in 1942. It is particularly significant that the industry drilled this increased number of wells in the face of manpower and material shortages, generally higher labor and materials costs, and a crude oil price structure, which reflected neither the broad war-time advances in drilling and operating costs nor the increased cost of replacing crude reserves.

Major results of the last years' exploratory and development drilling program include the extension of the West Edmond Field in Oklahoma, the extension of Ellenburger production in West Texas and into New Mexico, and the discovery of an important oil producing area in southern Mississippi. Several promising discoveries also were made in central Wyoming, and Alabama became an oil-producing state for the first time with the discovery of oil in Choctaw County near the Mississippi state line. Development of the Elk Hills Naval Reserve is already providing substantial additional quantities of oil in California where supply shortages are most acute.

Indications at this time are that new oil reserves discovered in 1944 will exceed those made during 1943, but it is not likely that the new discoveries will be sufficiently great, even with the addition of revisions and extensions to known fields, to offset the 1944 production of almost 1,700,000,000 barrels.

We are calling upon the producing branch of the industry to drill 27,000 new wells during 1945, including 22,000 development wells in oil, gas, and condensate fields, and 5,000 exploratory wells. This is deemed to be the minimum number of wells necessary to assure a sustained supply of crude oil adequate to meet anticipated war requirements. If sufficient materials, facilities, and manpower were available it would be highly desirable to drill 30,000 to 32,000 wells in 1945 to provide some margin of safety in crude oil productive capacity.

Unless the existing shortages of manpower, facilities, and certain items of equipment are eased as a result of military developments, we cannot expect to exceed the drilling program determined for 1945.

It is particularly important that exploratory drilling be continued at an accelerated pace during the forthcoming year. It is the new flush field which offers the most fertile source for immediately available additional productive capacity. Many fields discovered in the past year or two are today furnishing substantial quantities of oil for the war. The smaller size and lower productivity of the new fields and pools being discovered, however, make it imperative that total exploratory effort be further intensified.

It is apparent that the present rate of crude oil production can be sustained only if new reserves are discovered at least as rapidly as withdrawals are made from known reserves.

Likewise important in efforts to increase productive capacity is the continued expansion of secondary recovery and pressure maintenance operations. During the past year we have witnessed a substantial increase in the number of such installations, and the results have been exceedingly promising. The high rates at which many of our oil fields are being required to produce has increased the value of pressure maintenance and has fostered wider application of its use. The daily production of crude oil by secondary recovery methods has almost doubled in the past two years. Continuation of the present upward trend in these activities should be of great assistance in sustaining the present high rate of production.

In achieving the exploration, development, and production objectives for 1945 the industry undoubtedly will be handicapped, as in the past few war years, by shortages of materials and manpower. During 1944 shortages have occurred particularly in specific items of fabricated equipment, such as trucks, tires, heavy duty engines, and tractors for which the petroleum industry had to compete with other industries and with the armed services. In addition, it is expected that difficulties may be encountered in obtaining the industrys' requirements for oil country tubular goods because of the sharply expanded bomb and rocket programs.

Manpower problems that have accompanied the increase in drilling activity and the high rate of production may be even more numerous and severe during the coming year. In replenishing its ranks, depleted by the loss of technical and trained men to the armed forces and other war industries early in the war, the industry has had to employ inexperienced personnel with a resulting sharp decline in operating efficiency. Continued drain upon civilian personnel to fill manpower requirements of the armed services, coupled with the necessary overall expansion of production operations, indicates that no improvement can be expected in the manpower situation.

In conclusion, it should be emphasized again that production throughout 1945 at a rate of approximately 4,700,000 barrels daily will be necessary in order to meet fully the requirements of the war program, even though the European phase of the war is ended during the year. While foreign sources of oil will continue to be utilized to the fullest extent possible the limitation of transportation facilities will require a continued dependence on domestic sources. It is essential, therefore, that the domestic industry gear itself now to the maintenance of this high crude oil production rate and plan its operations for the coming year accordingly. The American petroleum industry has done a magnificant piece of work in meeting the enormous wartime demands for petroleum products and, without doubt, it will meet the even greater challenge with which it is now confronted. PAW stands ready to assist in every way possible.

DSM AWARDED TO GENERAL COVELL

MAJOR GENERAL WILLIAM E. R. COVELL, Chief of the Services of Supply for the India Burma theatre, was awarded the Distinguished Service Medal January 8 for his work in organizing the Fuels and Lubricants Division, Office of the Quartermaster General now headed by Brig. Gen. Peckham. General Covell left the post at the Office of the Quartermaster General a little over a year ago for the assignment in the Orient.

A native of the District of Columbia, General Covell had been retired from the Army about a year when, in 1941, he was recalled to active duty and assigned to the Offices of the Quartermaster General. Before taking over the assignment which led to formation of the Fuels and Lubricants Division he was division engineer in the Caribbean area in charge of Army construction work in the Caribbean Islands and Northern South America.

Presentation of the medal was made at the Office of the Quartermaster General, during a flying visit to Washington by General Covell. The presentation was made by Major General Edmund B. Gregory, the Quartermaster General, who read the following citation:

"Major General William E. R. Covell, United States Army. For distinguished and exceptionally meritorious service in a position of great responsibility as Director, Fuels and Lubricants Division, Office of the Quartermaster General, from 1 June to 23 October 1943. Assigned to head the Division upon its inception, General Covell, through able aggressive leadership and broad professional knowledge, established the plans, policies, and procedures to guide the Division in the successful accomplishment of its assigned mission. General Covell discharged his responsibilities in such a manner as to guarantee petroleum supplies sufficient for the successful prosecution of the war and without imposing unwarranted restrictions on other users."

General Covell graduated from Central High School in Washington in 1910, was honor graduate in the Class of 1915 at West Point in the same class with General Eisenhower.

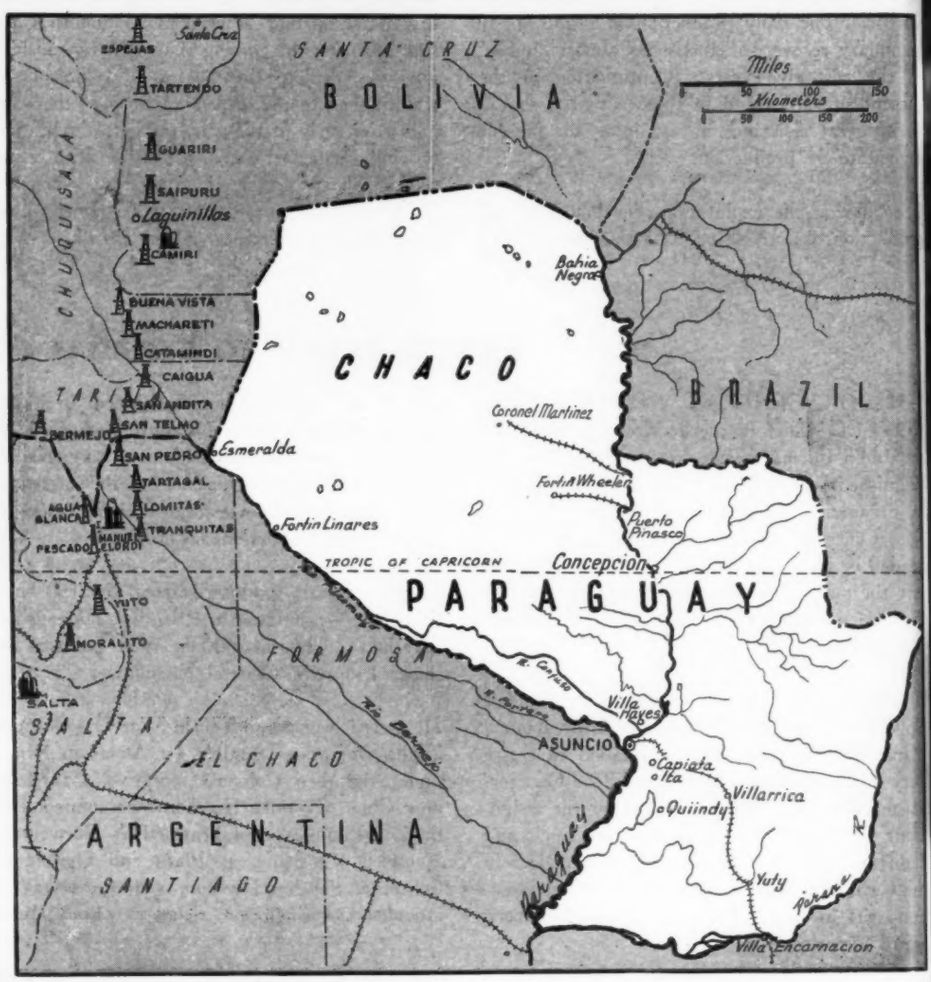
He served overseas in World War I as assistant in the Operations Section, 1st American Army, under the then Colonel George C. Marshall, now Chief of Staff. He then took command of the 2nd Enginers until May 1919. He went to Neuwied, Germany, as Plans and Operations Officer of the 2nd Division. After the war he attended the Engineers' School at Fort Humphries (now Ft. Belvoir), Va.; was district engineer at Buffalo, N. Y., for two years; attended Massachusetts Institute of Technology and graduated with a degree of bachelor of science in civil engineering, served for a time as personnel officer in the Office of the Chief of Engineers, and was assigned as assistant Engineer Commissioner of the District in 1924, a post in which he served until 1928.

Later he graduated from the Command and General Staff school at Fort Leavenworth, Kansas, and was executive officer at the Fort Humphries Engineer School. He was next assistant engineer of maintenance of the Panama Canal, then for four years was district engineer for Pittsburgh, a post in which he instituted and carried out much of the flood-control work in that district. In addition, he was active in the Organized Reserves of Pittsburgh.

Major General Gregory Presents Distinguished Service Medal to Major General Covell.

A. C. Rubel, Vice Pres. Union Oil Company of Calif.

Earle B. Noble, Manager of Exploration.



Upper Right: On the Fringe of the Gran Chaco Near Puerto Pinasco.

SEARCH FOR OIL IN THE CHACO

ONE of the least known areas in South America and one of the most interesting from the viewpoint of the oil prospector is about to be subjected to a scientific survey to determine the probability as to the existence of petroleum within its limits. This exploration is to be undertaken in pursuance of a decree law issued by the Paraguayan government which declared the whole of the Chaco Territory a reserved zone for prospecting for petroleum and authorized the Ministry of Public Works and Communications to enter into a contract with the Union Oil Company of California "for prospecting, investigating and exploiting" this area on behalf of the State.

Although the region is sparsely inhabited and totally undeveloped the name Chaco became a familiar one to people in all parts of the world a few years ago when the war between Paraguay and Bolivia was waged in the territory and largely for its possession. Even the extent of the area comprised within it is not known exactly but it is estimated to include between 54,000,000 and 58,000,000 acres and is, therefore, more than half the size of California. It includes approximately one-half the land surface of Paraguay, bordering upon Argentina, Bolivia and Brazil.

The contract for exploration, and for subsequent development should oil be found in commercial quantity, was concluded between the Minister of Public Works and Communications Capt. de Navio don Ramon E. Martino representing the government of Paraguay and A. C. Rubel, vice-president of Union Oil Company, representing the company. In effect it is a partnership arrangement between the government and the company by which the latter is to supply the geological and geophysical talent, find and develop the oil fields if any there are, and provide the necessary knowledge of drilling, transportation, refining and marketing with which it is equipped by long and successful experience.

Negotiations leading up to the present arrangement were initiated nearly two years ago and during the past twelve months Union Oil Company has conducted preliminary reconnaissance

Top: Chaco Nomads Shift Their Herds and Homes to Take Advantage of Grazing Conditions.

River Boats Loading at Concepcion.

Oil Installation at San Andita, Bolivia, Near Paraguayan Border.

surveys. Now that a contract has been definitely concluded the oil company has retained the Western Geophysical Company of Los Angeles, California, to make a comprehensive geophysical survey of the region, a task of unusual magnitude considering the extent of the area to be covered and its lack of all means of transportation and communication. Nevertheless, the work already is under way and is being directed by M. A. Boccolary of Western Geophysical. A fully equipped seismograph party headed by Frank Ellsworth is in the field and has started active operations. The equipment and personnel of this crew are forerunners of additional seismograph parties whose services will be necessary in order to carry out the exploratory program mapped out by the Union Oil Company.

In the matter of oil prospecting the Chaco is absolutely virgin territory. Paraguay has no oil production as yet. In the area about to be explored there are no known seeps or outcroppings such as sometimes help to guide the geologist or geophysicist. The Chaco is not known even to be within an oil province. A glance at the map will reveal, however, that geographically it is related to the Argentine Chaco, the site of known geophysical structures, while oil producing districts of Bolivia are adjacent to the Paraguayan frontier on the northwest. Since the terrain is as flat as the plains region of the United States, without outcrops, it is necessary to depend on the seismograph, not only to map structures but to draw inferences concerning the thickness of sedimentary sections.

In this almost trackless wilderness, populated only by a few Indians, small detachments of soldiers and a few hardy settlers, there is one passable road extending from east to west. Along this road the first seismograph line will be run for about 150 miles. This will provide a basis for establishing the major syncline of the basin as well as providing indications of any reversals that may be present. Following completion of this line detailed surveys will be made in local areas which present the most favorable aspects. Since actual drilling is contemplated within eighteen months every effort will be made to outline at least one suitable drilling location within that time.

When it comes to extending exploration into the interior it will be necessary to cut trails through the densely wooded area and to provide means for moving in food and supplies for the surveying crews. With the exception of one Mennonite colony and a few small army camps, there are no civilized settlements in the region. Practically everything needed will have to be brought in from Asuncion, the capital. The water supply, both for drinking purposes and for operations, will be provided by sinking water wells at camp locations. Buildings are now being constructed near the center of the area. These will serve as headquarters for the operations as well as providing housing facilities for the personnel. Complete auxiliary units must be built from time to time as operations are extended deeper into the interior and away from the main camp.

In carrying on the negotiations which led to the conclusion of the contract Mr. Rubel was assisted by G. Butler Somervell and Sanchez Albarran. The preliminary reconnaissance was directed by E. B. Noble, Max Krueger and Chester Cassel. Mr. Noble, who is now in Paraguay directing the general field work, was formerly chief geologist of Union Oil Company and now is manager of exploration.

REVISION OF ANGLO-AMERICAN AGREEMENT

Favorable Reception of Proposed Changes and a Considerate Attitude of State Department Held to Improve Prospect of Acceptance.

Washington

IN having the President recall the Anglo-American oil pact from the Senate and drafting a substitute of its own modeled along the lines of that suggested by the Petroleum Industry War Council, the State Department finally did what the industry wanted it to do in the first place; it let American oil men have a part in framing the agreement. It will be recalled that at the time the British and American delegates were holding their discussions the plea of the industry for representation at the conference table was denied. Instead, the best deal the industry could get was permission for a group of its own choosing to sit in an anteroom to answer questions relayed to it by the American conferees.

Now, in the final outcome, industry, it would seem, has had a definite voice in writing the terms of what will probably be the post-war international charter. Much delay in putting it into final form and much irritation undoubtedly could have been avoided, if industry had been given a voice in the proceedings in the first place. In recalling the original pact from Senate consideration, the President wrote:

"Pursuant to the recommendation of the Secretary of State, on August 24, 1944, I transmitted to the Senate for its advice and consent to ratification an agreement on petroleum between the governments of the United States and of the United Kingdom of Great Britain and Northern Ireland which was signed in Washington on August 8, 1944.

"At that time I considered that the agreement constituted an important step forward in removing possible causes of friction in international trade in petroleum and promoting cooperation among the nations in the development of that trade. I have not changed my opinion in this respect. However, I am informed that fears have been expressed as to the scope and effect of the document, as now worded; some voicing concern lest it authorize acts by the petroleum industry inconsistent with the provisions of existing law, others lest it hold potentialities harmful to the industry. It is my belief that these fears are without foundation. Certainly no such possibilities were intended or designed by the American representatives who negotiated the agreement.

"Since there is general accord that an understanding on international trade in petroleum between the United States and the United Kingdom is desirable and in the public interest, it would be unfortunate if this should be delayed, if not prevented, through a misunderstanding as to the purpose and scope of a particular document.

"The Secretary of State, accordingly, has recommended that I request the Senate to return the agreement in order that consideration may be given, in consultation with the government of the United Kingdom, to whatever revision appears to be necessary to achieve its objectives and to remove grounds for misunderstanding. I, therefore, request that the agreement be returned for this purpose."

At the same time the State Department gave out the following statement:

"The Department of State has consistently advocated the development of broad international understandings for the promotion of sound trade and commerce between nations as essential to the building of world-wide peace and prosperity. The Anglo-American oil agreement was concluded in an endeavor to apply this cooperative approach to particular problems and to lay the basis for the removal of possible causes of friction in the field of international oil.

"However, in view of the misunderstanding that has arisen concerning the purpose and scope of that agreement, the Department has requested the President to withdraw the agreement from the Senate. The purpose of this course is to permit consideration of the best way to achieve the fundamental purposes underlying the agreement—preventing friction between nations growing out of problems of foreign oil and assuring to all an adequate supply. It appears to the Department that the misunderstandings which have arisen come not from lack of agreement upon these objectives but from the implementing features attending them."

It is generally accepted here, both in official quarters and in oil industry circles, that the way has been prepared for fairly prompt action in obtaining acceptance of a substitute agreement that will meet the most serious objections raised against the original. At one time it looked as though a prolonged struggle was likely to take place between the administration and opponents of the pact who attacked it on the ground that it would open the door to federal control of domestic production and distribution. Antagonism was particularly strong and vocal among the oil men of Texas and the Mid-continent where various associations passed resolutions opposing the agreement and mustered sufficient strength among members of Congress to make it doubtful whether ratification could be obtained.

The break came when the National Oil Policy Committee of the Petroleum Industry War Council accepted the challenge thrown at them by Petroleum Administrator Ickes to be specific in their criticisms and in suggesting changes. The committee surprised both the friends and the critics of the proposed treaty by rewriting the entire document in language much more clear and direct than the original and in terms which removed the dangers that critics had found in it while preserving the objectives that it sought to attain according to the representations of the original framers. The committee in fact did such a good job of recasting that very little objection was raised on either side to the proposed draft. After careful study of the proposal the State Department apparently found only minor changes needed to make it acceptable. Its withdrawal of the agreement that had been transmitted to the Senate was taken as a tacit admission that a revision in general accordance with the committee draft would be adopted.

Recall of the pact was taken in well informed quarters as a tip-off that the State Department had already drafted its substitute agreement and had submitted it to the British, whose approval naturally must be obtained. Also it is assumed that the Department has received reasonable assurance the revision would be acceptable to the other side. Although the text of the amended revision has not been revealed here at this writing, there are indications that it will have fairly smooth sailing in the Senate, when it is submitted for approval, and will be acceptable to the industry generally.

It is understood that Chairman Tom Connally of the Senate Foreign Relations Committee, who came out flatly against the original agreement, had much to do with the State Department's request that the President withdraw it from consideration. Appointment of five new members to fill vacancies on the Foreign Relations Committee is decidedly favorable to an international agreement on oil. Only one of the five might on his record as a non-interventionist go against it. That is Senator Wiley, Republican, of Wisconsin. The other four, however, probably will go along with the Administration, assuming that the oil industry's objections have been overcome. They are Bridges, Republican, of New Hampshire; Lucas, Democrat, of Illinois; Hill, Democrat, of Alabama; and Hatch, Democrat, of New Mexico.

MILITARY NEEDS REQUIRE FULL REFINERY PRODUCTION

By A. P. Frame *Director Refining Division, Petroleum Administration for War*

Rising Demands for New Super-Fuels Will Offset Any Reduction in Total Volume of Products — Increasing Pressure for Aviation Gasoline

WE need full production!

That simple statement of fact is the first thought that crossed my mind when I was asked to contribute an article on the refinery outlook for 1945.

Yes, we need full production and we will continue to need the full measure of cooperation from every individual in the refining industry until our fighting forces once again bring peace to our homes.

So long as all-out war continues, the principal problem facing the refiners will be to maintain the scheduled production of all refined products.

I cannot foretell when the war will end any more than any reader of these lines. Nor will I attempt to usurp the functions of that soothsayer by hazarding a guess as to what the year holds in store.

However, there is one thing I can and will say and that is this: after victory in Europe the controlling factor in refinery operations will continue to be the military requirements for aviation gasoline. Refineries must be run in the manner best suited to meeting this demand. Aside from the interim period immediately after the cessation of hostilities in Europe, the demand for aviation gasoline, according to military information available to me, will be close to present levels of consumption.

Any reduction in the total barrels of product required will be offset by demands for the new super-fuel. As is well known, aviation grade gasolines are the cream off of the top of the barrel and any improvement in the specifications is achieved by increasing refinery runs or by substitution of the richer cream in smaller quantities. As a result, all of the special facilities, domestic and foreign, must be run at top speed to fulfill the military demands for aviation gasoline.

It is extremely difficult to forecast the extent to which military demands will draw upon such supplies. The military demand is strongly influenced by the fact that no real stockpile of petroleum products exists. Unlike other war products petroleum products cannot be stockpiled to any great extent but must be used shortly after being produced, even to the point that sometimes tankers, tank cars or pipelines are filled with fuel oil still warm from the stills.

Aviation gasoline has been used as rapidly as it has been produced and the prospects for creating a reserve of this vital fighting fuel are remote not only because of the size of the requirements but as a result of the limited storage facilities available for this purpose.

A. P. Frame

The shortage of manpower may be expected to be a very disturbing factor so long as the hostilities continue. Refinery operators must take every precaution to guard against extended "downtime" because when the refinery units are shut down either intentionally or as a result of an accident, it now takes longer to repair them and get them back on stream.

On the subject of downtime, it will be necessary that refineries take the absolute minimum, consistent with safe practices, from now until the end of the war. Every precaution must be taken to insure the full operation of present equipment for the all-out operation against the enemy in the Pacific.

While it is out of the question to schedule the overhauling of all refinery equipment during the interim period following V-E Day, it would be a very good idea for refinery operators to take advantage of this period of readjustment to inspect all equipment and insure as far as possible against untimely breakdowns as we enter the home stretch.

In any event, whether global war continues throughout 1945 or not, there is another serious refinery problem which will have to be met by many refiners, particularly in the Middle West (PAW District 2) and Southwest (PAW District 3). The supply of sweet crude is diminishing in certain areas and it will be necessary to replace this crude with sour crudes. For this reason more refiners must be prepared to handle the sour crudes rather than only the sweet crudes they have been using.

Throughout most of 1944 transportation of crude to refineries and transportation of products away from refineries was so arranged that it did not constitute a real bottleneck or impairment of refinery operations in any way except perhaps with respect to some isolated cases.

The increased short term requirements for 100 octane aviation gasoline on top of the unprecedented demands for military petroleum products probably represent the greatest problem which was introduced during 1944.

In view of that, we can hardly discuss the outlook for 1945 without taking into consideration the possibilities of a recurrence of these demands

Should the global war drag out through most of 1945 there undoubtedly will be a renewed cry for additional quantities of the same products so sorely needed during the last few months of 1944.

While these requirements were met, the meeting of them necessitated extreme regulatory measures with respect to the quality of refined products for civilians.

Military gasoline of a necessity has to be high octane gasoline and the amount of tetraethyl lead required is enormous, partly because of the increased volume of these gasolines and partly because military gasoline takes relatively the highest concentration of tetraethyl lead.

During 1944 we depreciated civilian gasoline from the standpoint of its volatility as well as its anti-knock qualities, and we are hopeful that the "low-point" of civilian gasoline quality has been reached.

The situation in regard to the manufacture and stock-piling of tetraethyl lead in the closing months of 1944 has shown a definite improvement and if this improvement continues into 1945 it should permit the manufacture of some additional sorely-needed premium gasoline for essential civilian users.

The situation at this time is tight and will continue to be so until military needs are reduced.

Pending such action, I can only repeat my opening remark:

During the entire year 1945, we shall need full production: Full production of crude oil, natural gasoline and liquefied petroleum products as well as full refinery operations and full utilization of our transportation facilities for the all out job of meeting military demands and essential civilian ration requirements.

CALIFORNIA DEEP WELL TEST EXCEEDS THREE MILE DEPTH

Ordinary Drilling Equipment Carried World's Deepest Bore to 16,246 Feet Without Serious Difficulty or Interruption

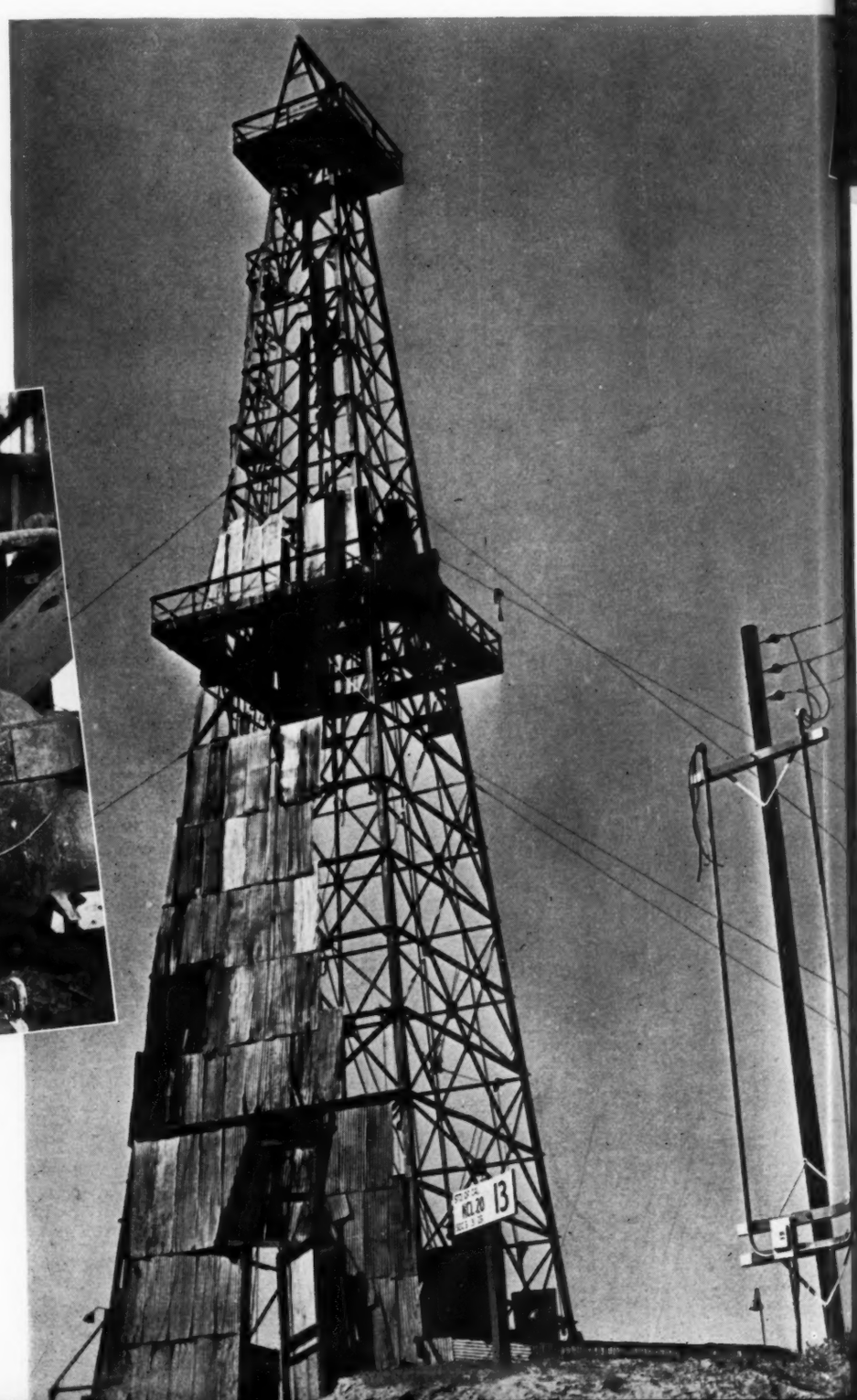
DRILLING of Standard of California's KCL 20-13, near Taft in the southern San Joaquin Valley of California, was discontinued at the end of December. Although finished as a dry hole it was carried to a depth of 16,246 feet and has the distinction of being the world's deepest well and the first to penetrate more than three miles below the earth's surface. Possession of the depth record, which passed to West Texas only a few months ago when the Price No. 1 of Phillips Petroleum Company was bottomed at 15,279 feet, has now returned to California where it previously had been held for six years by Continental Oil Company's KCL-A2 in the Wasco field.

Decision to suspend drilling of the KCL 20-13 was not forced by inability to carry it further but by the ending of any reasonable prospect of finding production and by the mechanical difficulties of operation. Drill pipe displayed a growing tendency to stick at the great depth reached. A round trip of pulling and replacing the pipe string for a change of bits consumed nine hours. The length of drill pipe might stretch as much as eighteen feet while twisting itself several times in communicating the turn from the rotary table to the bit.

Before drilling was abandoned, the bore had passed through the various formations from which oil is obtained in surrounding California fields. The strata of Pliocene age which are productive in the Buena Vista Hills and the Midway district proved barren in KCL 20-13.

Below 8,000 feet the Miocene formations which yield oil in the nearby Coles Levee and Te Section fields failed to reveal showings in thi well. Finally the drill penetrated the part o the lower Miocene which includes the Vedde sand from which oil is obtained in several loca

Drawing Mud for Test.



KCL 20-13—World's Deepest Well.

Inspecting Operations, Left to Right: Al Tietze, General Superintendent, Northern District, Producing Department; C. L. Brewster, Superintendent of Drilling; W. M. Quinn, Drilling Foreman.

Day Crew, Left to Right: Fred B. Snyder, Driller; D. A. Steakley, Relief Driller; Allen Snider, Rotary Helper, D. E. Behymer, Rotary Helper; Arthur Dix, Fireman.

tions on the east side of the San Joaquin Valley, including the Greeley, Rio Bravo and Mt. Poso fields. This likewise was non-productive and in the opinion of company geologists exhausted the probabilities of bringing in the well as a producer by increasing its depth. Some showings of oil behind the casing which extends to 10,999 feet are to be tested before final abandonment is decided upon.

The significant fact about KCL 20-13 and the feature that gives it exceptional interest to oil men is the fact that it was put down for its entire depth with ordinary drilling equipment no heavier than that which is used in the majority of 10,000 foot wells in California fields. The well was not started with the purpose of establishing a new depth record although it was intended to test deep formations in its location. Therefore, the equipment selected was such as the company is using in other nearby wells which are intended to go down from 10,000 to 11,500 feet. Of the three wells which have been carried below 15,000 feet this is the only one in which it has not been necessary to substitute some heavier equipment at the lower depths.

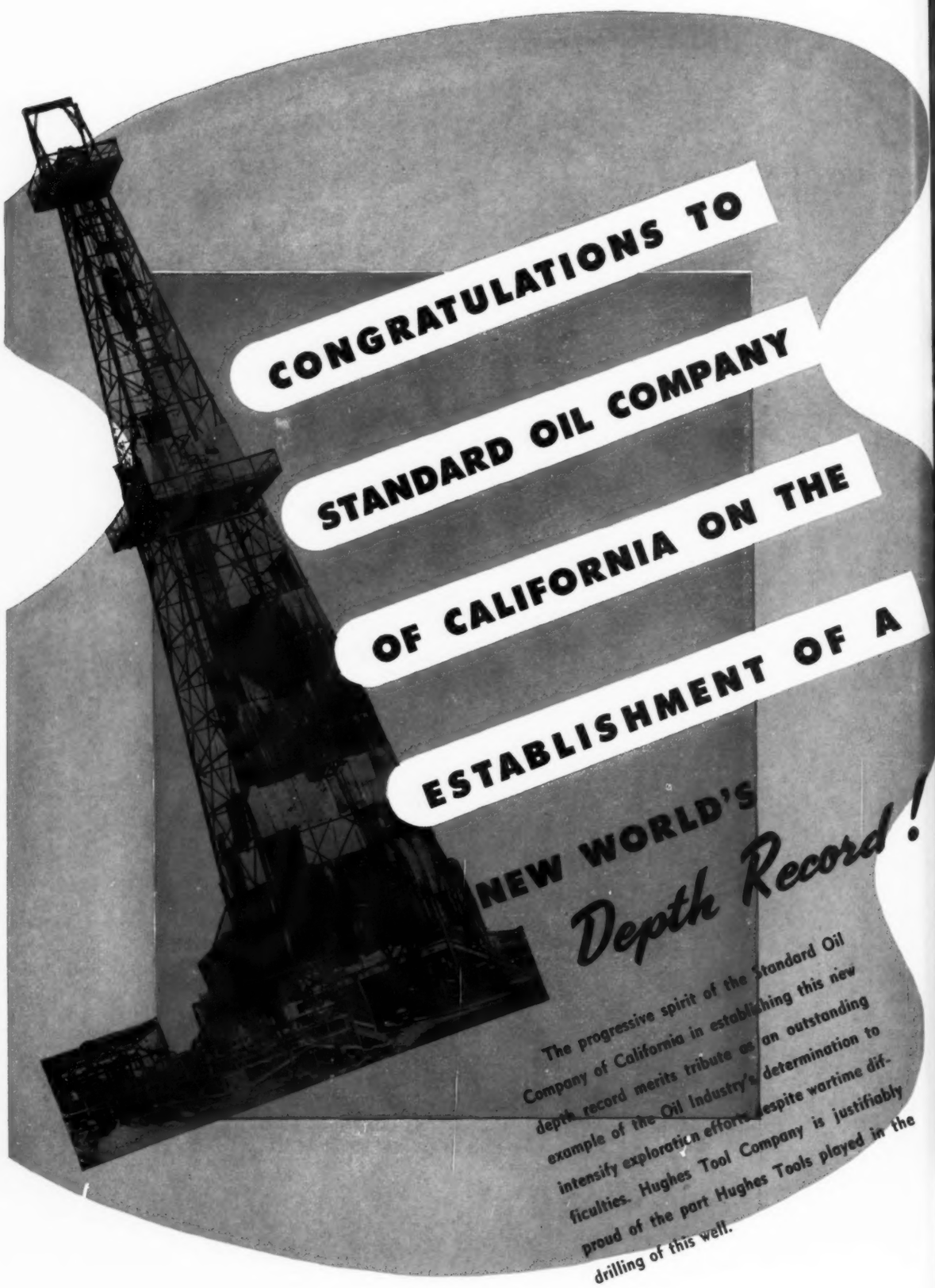
Another noteworthy feature in the drilling of KCL 20-13 has been the freedom from interruption or delays such as sometimes arise through accidents, loss of circulation or encountering difficult formations. For this exceptional record credit is due to the good judgment used in the selection of equipment and to the skill and carefulness of the crews and those in charge of the operation as well as to the fact that good drilling conditions existed throughout practically the whole course of the drilling. The location selected by company geologists was one that from past records was likely to give little trouble to the drilling crew. A firm but not excessively hard and largely flat structure prevailed throughout most of the hole. No trouble was encountered from caving and there was little loss of circulation. The mud engineers were able to maintain a good bore without any special treatment of the drilling fluid.

A battery of five Lucey 100 h.p. boilers supplied steam for the power plant used in drilling the well. Four of these were rated at 250 pound capacity and the fifth at 300 pounds per square inch. All boilers were equipped with continuous blow-down with automatic jets controlled by steam pressure. Jerguson reflex ganges, Leahy water level control valves and Reed and Everlasting blowoff valves were installed as safety provisions in accordance with the standard practice of the company. Zeolite water softening treatment was employed with an open type feed water preheater. Two Wilson Snyder 7 x 4½ x 10 pumps supplied feed water. The boiler plant installation also included Natural Gas Equipment gas burners and Pinkerton water level controls.

The well is surmounted by a Consolidated Steel derrick, 136 feet high with a 30-foot base and having a carrying capacity of 799,600 pounds. An Emsco steel sub-base provided space for the blowout prevention equipment and an under floor rotary drive.

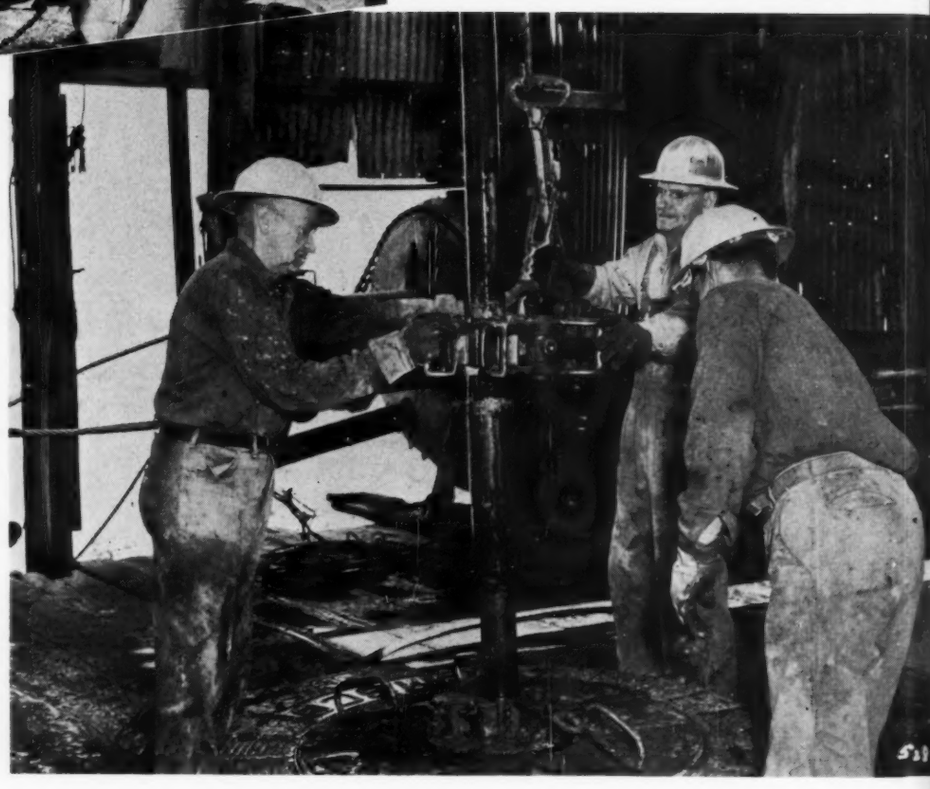
The draw works was of Emsco Derrick & Equipment Company construction and had seen considerable previous service. The drum shaft was of 10-inch diameter and the water cooled brake rims 54 inches in diameter. The draw works had been equipped with 3⅛-inch double sprockets and chain in the oil company's shops. A "gear-o-matic" cathead was installed on the rotary side of the draw works and Byron Jackson grips and rope guards safeguarded the catline. A grizzly wire line turn back roller was used on the driller's side of the drum and grizzly wire line savers guided the drilling lines. Two Parkersburg 30-inch hydromatic brakes mounted on opposite ends of the special drum shaft helped control the weight encountered in lowering the drill pipe. A Martin Decker "Sealtite" weight indicator provided readings on slush pump pressures, steam pressure, rotary table speed and weight on the bit, thereby aiding the driller to control operations and keep the hole straight.

The rotary table was driven by an Ideal Ajax 12 x 12 inch duplex horizontal steam engine. Power for hoisting was supplied by a Gardner-Denver horizontal twin steam engine. With a head of 250 pounds of steam this engine was able to raise 16,000 pounds of drill pipe in four hours. Going into the hole with control exercised by the daw works and the dual hydro-


CONGRATULATIONS TO
STANDARD OIL COMPANY
OF CALIFORNIA ON THE
ESTABLISHMENT OF A
NEW WORLD'S
Depth Record!
The progressive spirit of the Standard Oil Company of California in establishing this new depth record merits tribute as an outstanding example of the Oil Industry's determination to intensify exploration efforts despite wartime difficulties. Hughes Tool Company is justifiably proud of the part Hughes Tools played in the drilling of this well.

★ *Hughes* TOOL COMPANY ★

● HOUSTON, TEXAS



Above: Pulling Drill Pipe.

Upper Right: Allen Snider and D. E. Behymer, Rotary Helpers Tightening Draw Plug.

Right: Cluster Type Slips Hold Drill Pipe While Joints are Broken.

matic brakes required between three and a half and four hours. An Ideal Ajax 12 x 12 inch single steam engine was used to power the sand reel and the calf wheel dead line anchor. Both the rotary table engine and the hoisting engine were equipped with 4-inch Kerotest throttle valves and Okadee shut off valves.

Regan crown and traveling blocks carried the load from top to bottom. A seven sheave type "EM" crown block provided straight line reaving of the line and a 121-inch narrow double deck traveling block provided clearance in the derrick to rack 16,000 feet of drill pipe. Both crown and traveling block were equipped with 48-inch diameter sheaves grooved for 1¼-inch wire line.

A Byron-Jackson 300-ton hook with a duplex body permitted direct connection of the swivel to the elevators. Byron-Jackson 108-inch long links were used for carrying the swivel while rotating and for hoisting the drill pipe. The 2¾-inch diameter links proved adequate for this service, although they are not the heaviest manufactured.

Oil Well Supply 150-B swivel carried the load even at relatively high speed and with the great weight involved. Maintenance was reported as nominal on this item, despite the heavy load supported and the high pressure encountered. An Ideal swivel bail adapter was installed to allow for drilling from the links and elevator rather than from the hook body.

An Emsco type "JCS-20½" rotary table transmitted the power to the drill stem and is typical of the deep well rotary machines used by the Standard Oil Company. The spiral bevel ring gear and pinion provide quiet operation and long wear. The drive to the table was an Ideal type "BC" under-floor drive developed by the National Supply Company. This drive provides a clear derrick floor and is a great help to the cat head man. It also eliminates all rotation of draw works chain while drilling and allows for a better selection of speed on the table.

Ninety feet of 4¼-inch O. D. drill collars were used. These consisted of two 30-foot Baash-Ross collars and one 30-foot National Supply collar. A combination string of 5-9/16-inch and 4½-inch drill pipe was used down to 10,999 feet, where the 7-inch casing was set. At this point the combination string was laid down and a string of 3½-inch pipe with Hydril "Internal Flush" joints was placed in operation. As drilling progressed the small clearance between the 4¾-inch outside diameter of the

tool joints and the 5⅝-inch nominal diameter of the hole caused excessive torque. At approximately 11,212 feet the drill string was revamped and Hydril "Slim Hole" joints installed on pipe rotating below the 7-inch casing.

When the record was broken all drill pipe was grade "E" alloy pipe made up into a combination string. The top 49 strands, approximately 4300 feet, was equipped with Hydril "Internal Flush" joints, and this pipe was a combination of Jones and Laughlin "Blue Ribbon" and National Tube "High Tensile" pipes.

The next 111 strands, approximately 9900 feet, were Youngstown "Yoloy" with the Hydril "Internal Flush" joints cut off and 3½-inch Hydril "Slim Hole" joints pressure welded on. The remaining drill pipe was Spang "N-80", originally purchased with Hydril "Slim Hole" joints.

Grizzly 5½-inch O. D. casing protectors were used on all drill pipe rotating inside the casing with about one protector to each stand of pipe. A Patterson Ballagh drill pipe wiper also was used.

A highly important factor in drilling is the continuous operation of the slush pumps. On KCL 20-13 two steam pumps performed this duty. One was a Gardner-Denver 18 x 8 x 20 type FH and the other an Oil Well Supply 16¼ x 7¾ x 20, Number 20. These two pumps were compounded and the mud pressure varied from 1800 pounds to 2300 pounds from the day 3½-inch drill pipe was installed at 10,999 feet to the completion of the well. There were no standby pumps.

Above 10,999 feet a combination string of 5-9/16-inch and 4½-inch pipe was used and the mud pressure was between 1000 pounds and 1100 pounds. The pressure jumped to 1800 pounds when the 3½-inch drill pipe was installed after the casing had been set. The pressure increased between 1900 pounds and 2100 pounds when slim hole joints were installed on the pipe at a depth of about 11,040 feet. The pressure varied little from this depth on. 2300 pounds were reached at approximately 14,000 feet and this proved to be the maximum obtainable with 250-pound steam and 7-inch liners.

Two auxiliary mud pumps were used in addition to the mud circulating pumps. An Ideal 14 x 6¾ x 14 pump was used for circulating mud over the degassing tower and a Gardner-Denver 14 x 7¼ x 14 pump was used for mud mixing and moving mud as required.

Careful attention was given to re-conditioning all drilling fluid before it was re-introduced into the hole. Two Link-Belt 48 x 60 inch mud screens powered by independent three-horsepower electric motors screened all the mud.

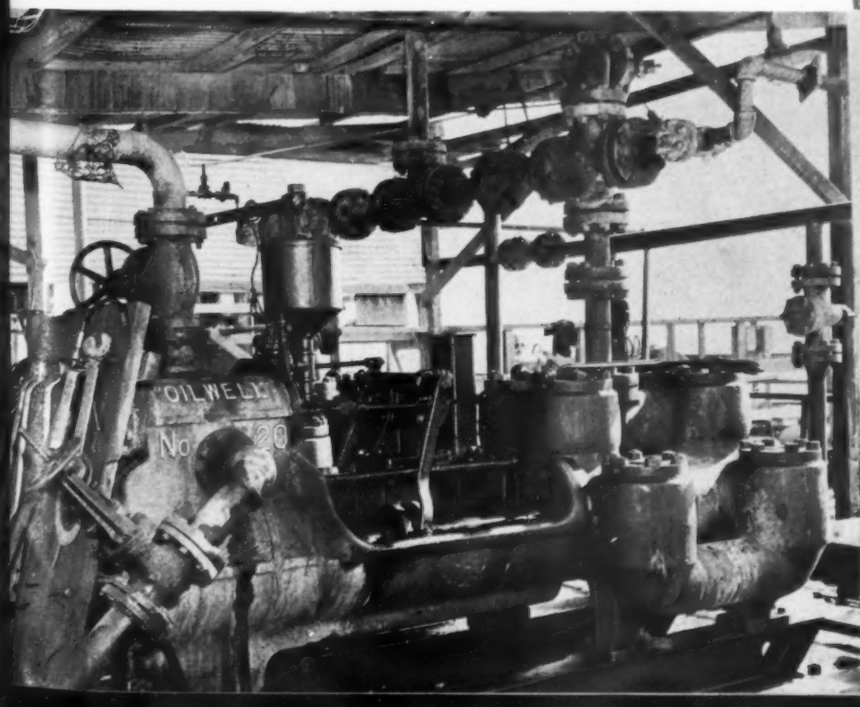
A Standard Oil Company built degassing tower was used to further recondition the mud. This tower was in the nature of a fish ladder over which all the mud was pumped and allowed to cascade down. Colloidal lumps were broken up, the gas was given a chance to escape and the temperature of the mud was reduced by this action.

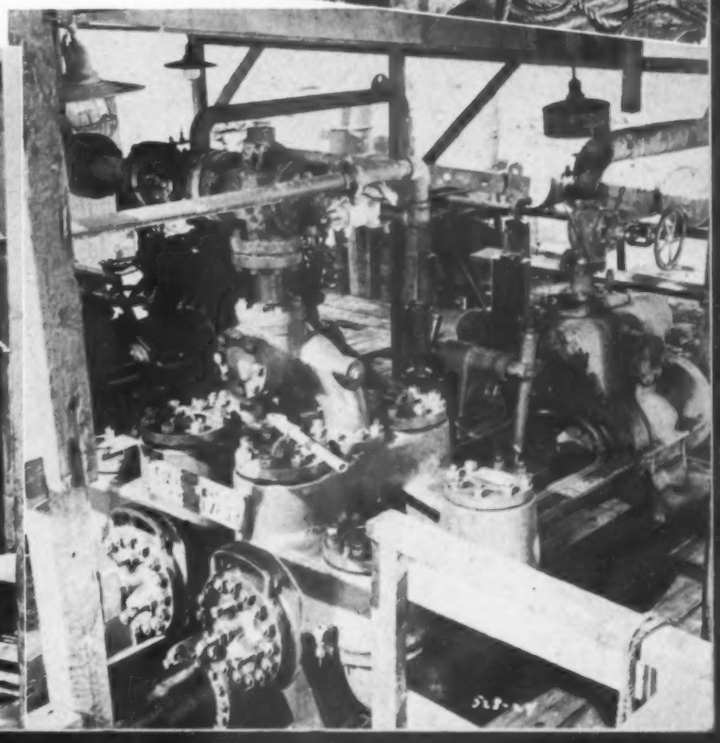
The engineers were required to make very few tests on the mud on this record breaking well. Routine periodic tests were made by the specialists but the bulk of the mud control was handled by the drilling crew.

The salt content of the mud was a good indication of the hole conditions. The concentration gradually increased until it reached 310 grains per gallon at about 13,900 feet. At this time the weight of the mud was increased from 78 pounds per cubic foot to between 83 and 85 pounds in order to keep the salt water in the formation. At approximately 14,000 feet the salt content was up to 680 grains, and the weight was increased to 97 pounds by the addition of Baroid. Pyrophosphate and Quebracho were used to control viscosity, water loss and wall building qualities of the mud.

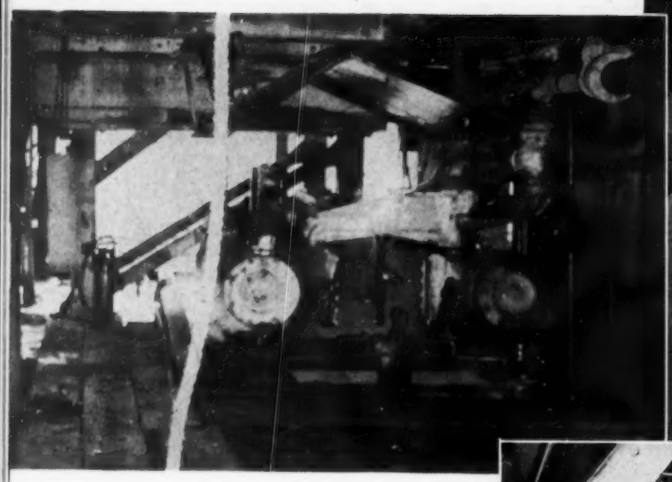
Continuous coring was done from 9213 feet to 9590 feet by the use of wire line core barrels. Hughes, Allen and Dunlap wire line coring equipment were all used in this section of the well. Below 9590 feet conventional coring bits were used for taking spot cores. Hughes and Allen bits were used for this purpose.

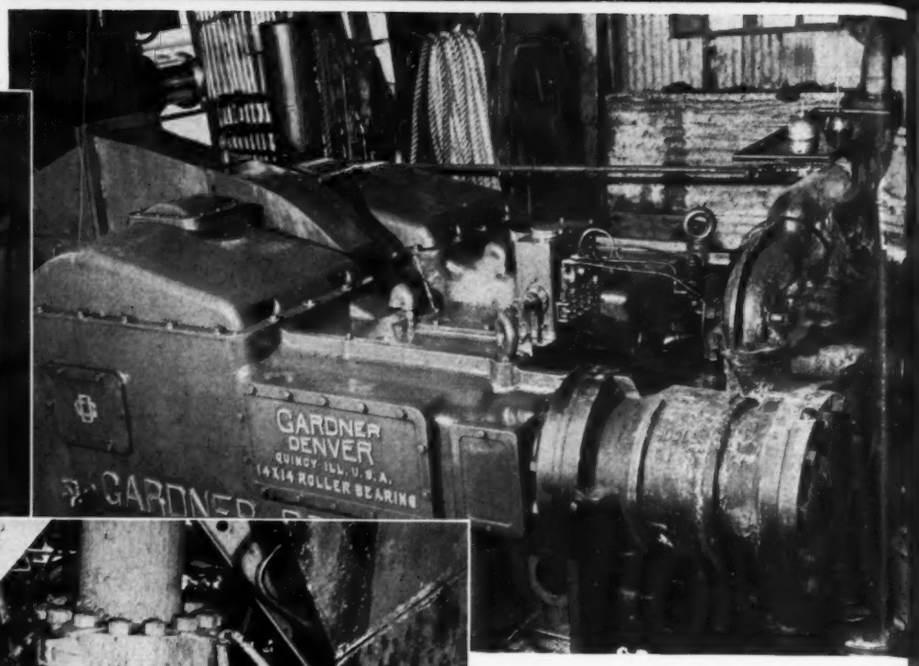
Running Drill Pipe on World's Deepest Well.





Lower Left and Right: Oilwell and Gardner-Denver Steam Pumps Handled Mud Circulation.





Above: National Supply Underfloor Rotary Drive with Ideal Engine.

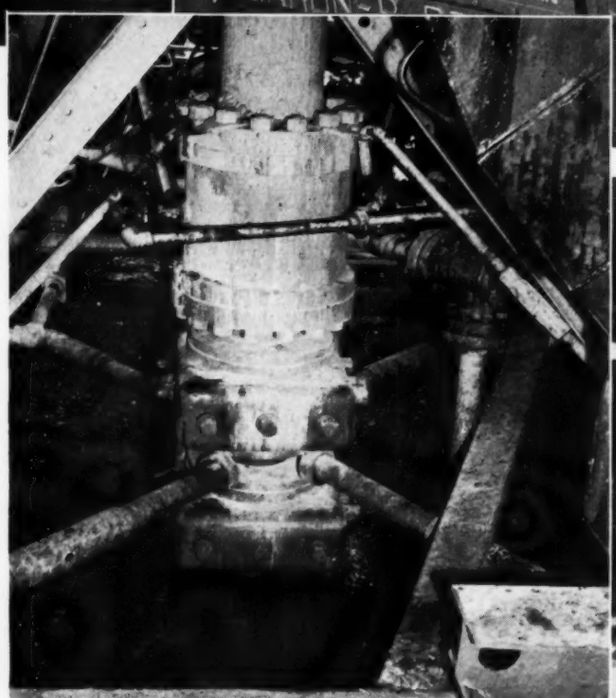
Upper Right: This Gardner-Denver Drilling Engine was One of the Few Heavy Duty Pieces of Equipment.

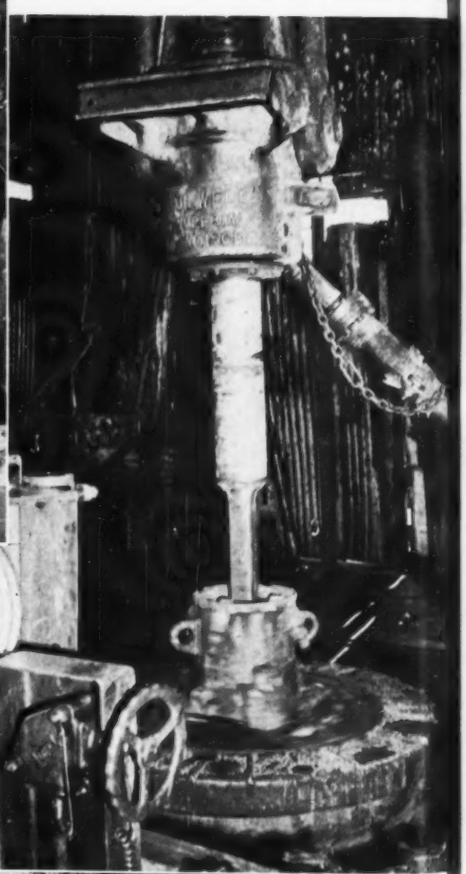
EQUIPMENT USED IN THE DEEP WELL TEST

Right: Shaffer Gates and Regan Packer Provided Adequate Blowout Prevention Equipment.

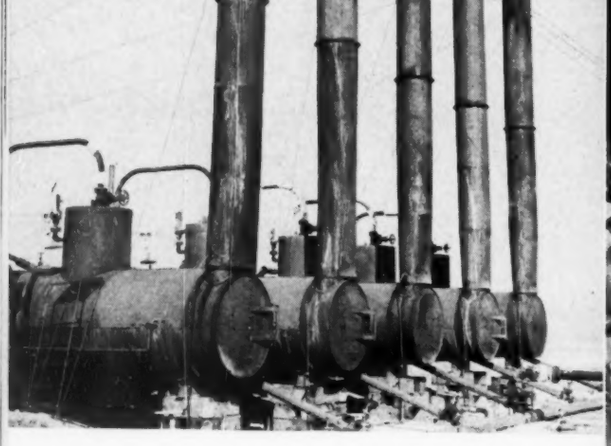
Lower Right: Parkersburg Hydromatic Brake at Left and Martin Decker Gauges at Right Aid Drillers Work.

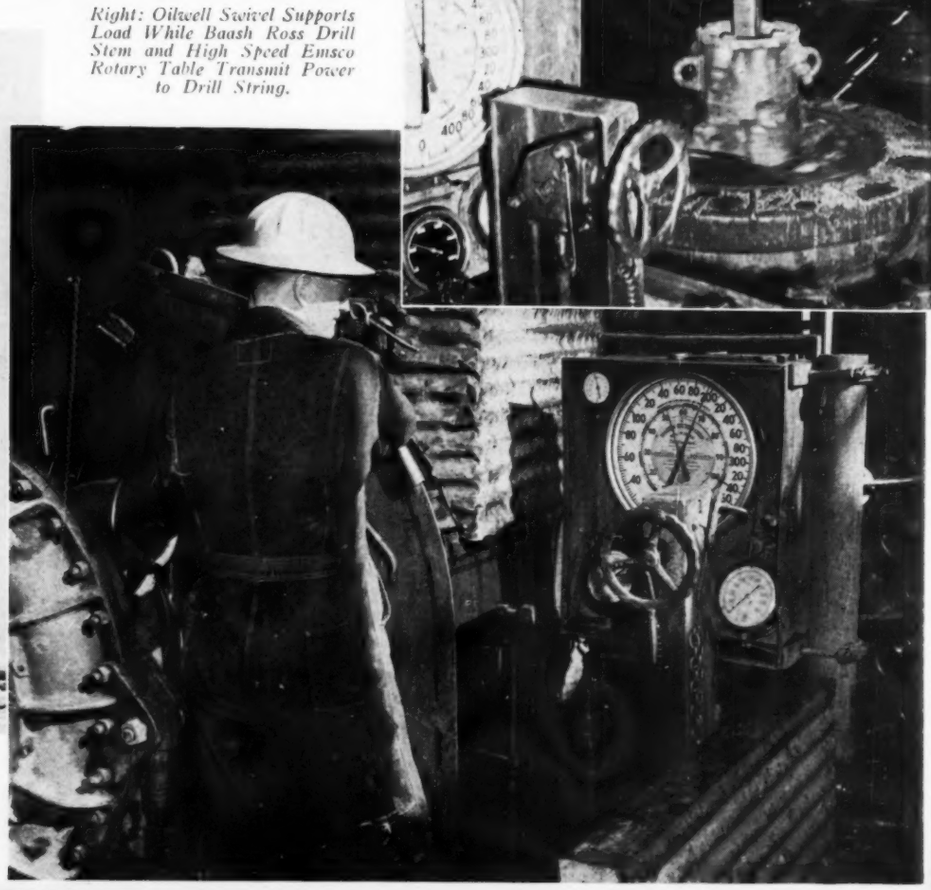
Below: Five Lucey 100 Horsepower Boilers Powered Drilling Equipment.





Right: Oilwell Swivel Supports Load While Baash Ross Drill Stem and High Speed Emsco Rotary Table Transmit Power to Drill String.





ECONOMIC FACTORS TO DETERMINE FUELS OF THE FUTURE

By B. H. Weil *Chief Information Specialist, Chemistry Division, Gulf Research & Development Company*

ONCE upon a time, when man lived in caves, the fuel problem caused him relatively little concern. When his drafty domicile got too cold and his fur-lined dinner jacket began to feel inadequate, he would "cast another log on the fire," poke it a few times to make sure it caught, and then settle back to have his anterior toasted, although, unfortunately, he could hardly feel warm both fore and aft at the same time.

Today, however, the fuel situation is a bit more complex. Then, fuels meant heat alone; now, they mean motive power and light generation as well, not to mention their industrial applications. The cave man fought his wars with clubs, stones, spears, and crude bows and arrows; "civilized" man uses rocket bombs, incendiaries, and flame-throwers. Whether these latter refinements in the fine art of destruction constitute real progress is not altogether clear, but it is entirely evident that progress has been made in keeping us warm, carrying us effortlessly on our way, and providing us with products unobtainable if modern fuel technology had not been developed.

Not that science is as yet able to perform miracles. Atomic energy remains untapped. The tides go unharnessed. The rays of the sun beat down during the day only to have the heat which they give the earth become dissipated during the night—barring that part, of course, which nature uses to grow crops and forests. The potential and kinetic energy in flowing and falling streams is tapped by numerous hydroelectric plants and, in some places, by water mills, yet by far the greater part is permitted to escape. More of these latter types of energy could be used if man became desperate, if present day economics were to go by the boards; more will be used as science develops new techniques and a better understanding of principles.

Until all this comes about, however, the principal sources of the energy which man will use for generation of heat and mechanical work will continue to be those substances which nature used (many years ago, usually) to store the plentiful solar energy of those tropical periods: coal, petroleum, and natural gas. Continued use will also be made of substances derived from these basic fuels, hence retaining at least part of their calorific value.

Throughout history, man has used for fuel and energy those substances which were most abundant and inexpensive. This practice continues today, although the complexity of our civilization has caused some fuels to be given a higher monetary value per calorific unit than others because their physical nature has made them easier to apply. For example, the machine age has brought into being such mechanisms as the automobile, for which liquid fuels have proved most desirable since their nature makes the feed problems relatively simple, thus keeping the weight and size of portable storage units to a minimum. Numerous foreign countries, lacking ready sources of petroleum, have used and are using combustible gases for automotive fuels but have neither been able to duplicate the performance of gasoline and Diesel fuels nor do without heavy storage tanks (since gases must be highly compressed if any amounts are to be carried) or bulky generators if the gas is to be generated *in situ* from such solid fuels as coke, wood, corncobs and the like.

Similarly, the fuel gases are highly prized for home and industrial uses, where the ease with which they may be used when desired, without the need for at-the-site storage, gives them an edge over coal and oil.

Monetary and technical considerations, however, have a way of playing hob with fuel situations. Let natural gas increase in price; thereupon numerous house dwellers shift back to coal or oil. Let a state increase its tax on gasoline; purchasers of trucks and buses then give close attention to the practicability of using Diesels. Let a revolutionary device such as jet propulsion become practical; airplane manufacturers at once consider its application to planes of all types, leaving the petroleum industry to wonder what types of aviation fuels will be required ten years hence.

To cap the climax, so to speak, is the problem of supply. This may not affect us today other than as regards shortages directly attributable to the war, but it may very well alter our "world of tomorrow" before a great many years have passed. We have given little attention to this matter in the past, save for rare moments when the force of statistics struck a particularly hard blow, for Yankee ingenuity has each time given these statistics the lie for at least a few years. As regards petroleum, for example, we are again in a period when statistics seem be speak volumes concerning the future domestic picture. The discovery of new and unaccounted fields may again, as it has in the past, becloud the issue, but it would seem fairly evident that domestic supply will fall behind demands in the not too distant future. This statement is predicated upon the following logic: (1) our "known" reserves approximate 20 billion barrels of oil; (2) our 1941 production, which might be accepted as representative of what may be expected in the immediate postwar years, was 1.4 billion barrels; and (3) 20 billion barrels divided by 1.4 billion barrels per year, or roughly 14 years, does not represent the life of our present reserves.

Actually, if no more oil were discovered, and imports were impossible for some reason, we would not be able to continue even our peacetime rate of consumption for the evident reason that we could not continue to produce that much crude oil. Estimates of reserves are based upon oil recoverable by present-day methods which strongly emphasize conservation and production over a long period; if these methods are disregarded and all-out production attempted, the figure of 20 billion barrels would shrink considerably, nor could the remnant be produced in 14 years in any case. It is said, in fact, that our wartime demands for more and more crude at once have already caused the need for a downward revision in estimates. It is obvious, of course, that more oil will be found—probably much more oil. It is equally clear that we shall import oil when and as we need it; oil has already been imported for some years from Latin American countries such as Venezuela and may even, at some future date, be imported from the Middle East, where estimated reserves dwarf our own.

The bugaboo of a petroleum shortage, however, has several aspects. Granting, if you will, that domestic reserves will sooner or later prove inadequate, it would appear that world reserves will still be ample for a much longer time if consumption within the respective countries maintains anything like the present ratio. All would thus be well and we could again bury our heads in the sand were it not for the evident fact that the Atlantic Charter is not going to be strictly followed, that "power groups" are going to continue to make a hash of even reasonable and not starry-eyed attempts to apply the Four Freedoms. The international history of petroleum has a somewhat unpleasant smell; the future may not be so very different. Not that we are likely to lack oil (in peacetime) if and when we need it; enterprising domestic petroleum companies have acquired their share of foreign fields; the question is rather one of ham-stringing exchange agree-

Footnote:
Paper presented before Northwestern Pennsylvania Society of Engineers, January, 1945.

ments and other actions which do not exactly coincide with the best ideals of future inter-Allied harmony.

Another aspect concerns the possibility of another war or wars. We have already been taught one lesson in this war—by rubber. If we depend upon foreign petroleum to make up future domestic deficits, we may at some later date be faced with a problem which we cannot solve in time. The implications here are obvious; the solutions are not. One of them—the use of petroleum substitutes—will be discussed later.

In regard to coal, however, another picture presents itself. This is graphically illustrated by a recently-made comparison of oil and coal reserves which states that if present United States petroleum supplies were to be spread over the state of Ohio (14,000 square miles) they would cover it to a depth of only three-quarters of one inch, while United States coal deposits would bury Ohio in a layer 76 feet deep! It has been estimated that, if used at the 1941 rate of production, the United States' reserve of 3,178 billion tons of all types of coal would last for some 3,000 years! Some grades of coal, such as anthracite and low-volatile bituminous, at the 1941 rate, would only suffice for a few hundred years, but the over-all situation presents a startling contrast to oil.

Natural gas prospects are of an intermediate nature. Known domestic reserves are estimated at 110 trillion cubic feet—enough to supply the nation for nearly 30 years at the 1941 rate of production. The picture is further brightened by the fact that the ratio of natural gas to oil discovered has steadily increased in recent years, and it is believed that potential total reserves are on the order of 300 trillion cubic feet, or three times the amount of known reserves.

None of these "life" figures, of course, has any real meaning, for it is impossible to predict future demands other than to guess that they will continue to increase, thus reducing the life expectancy of the reserves. Future supplies of other fuels, such as coke and manufactured gas, depend upon the raw materials from which they are derived; since this is usually coal, no fear of shortage is felt.

Turning now to the subject of replacements for those natural resources which are in short supply, we find that the picture is confused, but only by economics. The word "only" should not be stressed, however, for economics are a dominant factor in our republican form of civilization. Were this country under totalitarian rule, we could (as regards technology) shift to synthetic gasoline, for example, in as little time as would be required to build the plants to make it from coal or natural gas—perhaps five or six years if construction material demands were not allowed to disrupt other industry requirements. The cost, however, would be appalling. At the 1941 rate of gasoline consumption, our annual gasoline bill—at the refinery, before taxes, and without profit to the manufacturer—would fall between two and five billion dollars, compared with about 1.5 billion dollars in 1941 for the present-day petroleum industry. And the cost of the plants needed to produce this amount of gasoline—about 26,000,000,000 gallons per year—might be somewhere between five and thirteen billion dollars! Translating these figures into the cost of gasoline at the filling station, we would find ourselves paying the attendant between 27 and 32 cents per gallon for the same grade of gasoline for which we now pay 22 cents.

These figures are largely based on extrapolated European technology and represent what we could do if we had to replace petroleum now; American ingenuity is such that it is certain that costs can be lowered and that the public can expect gasolines of the present or slightly better quality—if that will suffice—to be available, for generations to come, at an average of not more than five cents per gallon above present prices.

The alarming part of the situation, however, is concerned with the danger of another war, which may come in the interim between the semi-depletion of petroleum reserves and the time when prices are high enough to permit profitable operation of substitute processes. This period may be lengthy, for vast quantities of foreign petroleum can be imported at prices competitive with or not far above present levels. And, as mentioned, a substitute petroleum industry cannot appear overnight, for the erection of plants would require perhaps 10 to 20 million tons of steel—11 to 22 per cent of our annual wartime capacity—in the form of towers, drums, piping, forgings, compressors, pumps, reactors, and other items which require fabrication facilities as well as raw materials. It is for this reason that properly-directed, fundamental government research, lacking the profit motive, can be of value in exploring phases of the subject which may later aid in hastening the day when substitute processes will become commercial. Such research, as we know, is envisioned in the five year $30,000,000 research program now being conducted by the Bureau of Mines. Data obtained should prove a valuable addition to that already held and rapidly being acquired by the petroleum industry itself. Whether all this work will suffice as insurance against a petroleum shortage in another war, however, is another matter. No one answer to that problem is evident.

Any detailed discussion of or comparison between the known processes for the synthesis of petroleum is not timely here. In brief, they are:

(1) The hydrogenation of carbon monoxide, called the Synthine or Fischer-Tropsch process. This process, using natural gas, is almost competitive with crude petroleum, and several plants using it will probably be erected shortly after the war. Since natural gas supplies are far from inexhaustible, however, it is certain that coal will eventually have to be used as the raw material. Even then this process appears attractive, for it may be possible eventually to bring the cost of gasoline produced by it down to as low as nine cents per gallon, which would be competitive with petroleum at $2 per barrel.

(2) The preparation of shale oil, either by pyrolysis of pyrobituminous shale fragments or by hydrogenation. By use of the former method, considerable quantities of oil can be produced at costs comparable to or not much higher than present levels; the total oil content of known oil shale reserves may approximate 100 billion barrels, a figure five times as great as that for known petroleum reserves.

(3) The separation of oils or tars from sands such as are found in the Alberta province of Canada and in California and Colorado. Vast quantities of such sands are known, possibly containing more than 250 billion barrels of tarry oil, but it is questionable if more than a few billion barrels can be obtained at anything like present petroleum price levels.

(4) The carbonization of coal. The small quantity of tars and oils obtained per ton are susceptible to cracking or hydrogenation for the preparation of gasoline, or, in some cases, can be used directly as fuel oils. Yields per ton by any known process are so low, however, that little use can be expected for them except where a ready market can be found for the major product, coke. A combination of coal carbonization with the Synthine process is possible, however, since coke is required for most of the present types of that method which stem from "coal".

(5) The hydrogenation of coal. As we have seen, coal is a most abundant substance; hence it constitutes the best raw material for use in any process for the long-term synthesis of petroleum-like oils. The hydrogenation of coal, however, is so complex and requires such expensive and elaborate equipment that it appears likely—unforseen developments aside—to be less attractive than the Synthine process using the same raw material.

Other substitutes and substitute processes exist but are more or less uneconomic on a comparable scale. As mentioned, producer or water gas generators may be attached to vehicles or stationary engines and the fuel gases used instead of vaporized liquid fuels. Other and compressed combustible gases—natural or synthetic—may also be used. A recent announcement claims the synthesis of "protoproducts"—oil-like materials—by controlled internal combustion of carbohydrates under high pressures, followed by cracking or hydrogenation. "Power alcohol," the perennial toy of the various "farm blocs", will probably be advanced again and again, although costs by any known methods using any known materials are not competitive even with the hydrogenation of coal except for

the production of relatively insignificant quantities.

In regard to fuel gases, the obvious substitutes for natural gas are the so-called manufactured gases—coke-oven gas, water gas, producer gas, and the like. These cannot at present compete with natural gas where the latter is cheaply available, but in 1939, for example, sales of the manufactured gas industry amounted to nearly 500 billion cubic feet, compared with natural gas sales of about 1,500 billion cubic feet; both figures, of course, have since been exceeded, especially that for natural gas. Of particular future interest is some research being conducted on the synthesis of high-B.t.u. gas by the Institute of Gas Technology, which is exploring the Synthine process as a means for either providing gas enrichment materials or the actual upgrading of low-B.t.u. gases such as water gas into high-B.t.u. "synthetic" natural gas. There would appear to be no danger of a shortage of gaseous fuels; higher prices, however, may cause abandonment of some of their uses.

Many of the subjects discussed so far relate to the comparatively far-distant future, even though they require present consideration. It may now be of interest to take a glance at what may be expected of the fuels of the immediate future, a period which will see crude petroleum derivatives still supreme among liquid fuels and natural gas still cheap and abundant.

All of us are now interested in a certain fuel whose wartime shortage has caused us considerable inconvenience—gasoline. Before the war, those of us who were not connected with the petroleum industry paid relatively little attention to matters concerning this substance. We were vaguely familiar with the term "antiknock" and the arbitrary system of octane numbers used to measure this property, but we took as gospel such sayings as "all gasolines are alike", used premium-grade fuels chiefly where the prices of both grades were rendered so high by taxation that the differential seemed negligible, and had no idea that "aviation gasoline" was anything but a somewhat improved variety of the gasoline we were using in our cars. Wartime experiences and the record of our air armadas have changed all this, however, and while "3-C" and "1-C" gasoline ratings are not common expressions, we are all familiar with the fact that our aviation grades of gasoline run way off the octane scale and that still better "superfuels" are required for B-29 and other recently developed dragons of the air.

Wartime aviation gasolines are typical of the highly-refined products which the petroleum industry is now able to produce. They are "gasolines" only in the sense that they contain selected hydrocarbons boiling within the gasoline range —"chemical gasolines" might be a better name for them. Certain premium gasoline fractions are blended into the present Grade 115-130 type, it is true, and form an important part thereof, but the major constituents are isooctane itself—synthesized from petroleum gases; isopentane—a hydrocarbon carefully fractionated from other hydrocarbons in refineries and natural gasoline plants or synthesized by "isomerization" from the far-less-desirable normal pentane; such "secret" and semi-secret blending agents as "cumene" and "C-S" which give "rich-mixture" performance—the ability to climb swiftly and take off with heavy loads; and Ethyl fluid—familiarly known as "lead" because of the tetraethyl lead it contains. The octane number of the final blend depends upon the relative proportions of the constituents used; the "superfuels" soon to be required will contain lesser amounts of the lower-octane substances.

Much publicity has been given to the fact that the production of aviation gasoline now exceeds 500,000 barrels a day. This is more than a ten-fold increase over pre-Pearl Harbor levels and represents a gigantic accomplishment, nor is the task completed. What is unfortunate in this publicity, however, is the fact that numerous uninformed writers, noting that 500,000 barrels per day is about 30 percent of our 1941 gasoline consumption, have arrived at the conclusion that, since aviation gasoline has an average octane number of, say, 110, and since pre-Pearl Harbor gasolines averaged about 76 octane number, then postwar automotive gasolines ought to have octane numbers of over 90 or else that large quantities of 100-octane gasoline are going to be available for automotive use.

There are numerous technical fallacies involved in the first premise; among them, that the gasolines just won't mix quite that way. The economic fallacies of both conclusions are even more serious: aviation gasoline blending agents cost at least more than twice the figure for an equivalent volume of straight gasoline, and many present plants can produce such agents only through highly uneconomic operations. The automobile industry comes in with a third objection; they state that they cannot, at least at present, design automobile engines which can derive any additional benefit from gasolines of higher octanes than 90 without running into mechanical difficulties which are as yet unsurmountable; pre-ignition of such fuels adds to the problem. The final touch is added by the fact that for three or four years after the war the great majority of cars will be of prewar origin; hence only a small number of these would benefit at all from gasolines above 82-85 octane number.

There is no doubt, of course, that postwar gasolines will exceed prewar gasolines in octane numbers. Numerous and large catalytic cracking plants, capable of turning out high-octane motor gasolines, have been built as part of the aviation gasoline program and will probably not be needed for that purpose in the postwar era. The fate of alkylation and isomerization plants is by no means certain, however, since their capacity will greatly exceed peacetime aviation needs and the costs of their products are far too high to use them in automotive gasolines, except in special instances.

It has been estimated—chiefly on an "expert opinion" basis—that postwar "regular" gasolines may not be higher than 78-octane in the immediate postwar era and that the octane rating of "premium" fuels will not exceed 82-85. It is highly likely that a few companies will surpass these levels for at least a brief period, but the value to the public will be questionable although advertising staffs will be highly elated.

There are basic chemical as well as mechanical problems involved in the use and production of high-octane gasolines. The type of hydrocarbons found in most straight-run gasolines and in many cracked gasolines do not have high octane numbers. Catalytic reforming processes increase the concentration of those hydrocarbons whose structure is more favorable, but some of these compounds, such as olefins and aromatics, have drawbacks, such as a tendency to preignite. "Branched-chain" hydrocarbons are also of high-octane quality, especially when the degree of branching is high, but it is not so easy to increase their concentration greatly. This is possible in the "chemical" aviation gasolines, but, the cost of such blending agents may prohibit wide use in automotive fuels.

It would seem, therefore, that the petroleum industry will do well to produce gasolines of 85 to 90 octane number which have satisfactory all-around qualities. If engine designers ignore the basic chemistry involved in fuel production and insist and succeed in passing these levels in the fuel requirements of their engines, the petroleum industry, as usual, will probably be able to meet the challenge, but with no assurance that costs will remain the same and with no guarantee that very large quantities of such fuels can be produced.

We have paid little attention, so far, to the type of automobiles which will be available after the war to use whatever fuels are produced. Much fantastic dreaming has been done on this subject, with the result that the public in general has been educated to expect something it is not going to get. E. C. DeSmet in a recent speech before the Society of Automotive Engineers has characterized these "dream cars" as a "cross between an oversized beetle and a traveling showcase". Petroleum technologists are prone to be equally impatient with these rash predictions; J. B. Holland, for example, has described the designers' dream as an "automobile that looks like a peripatetic solarium. It is made of plastic, magnesium, or just spun air—preferably hot. In the lower price ranges the postwar cars will burn 100-octane gasoline, but the super de luxe models will require something much better—150-octane is mentioned as a possibility. Presumably exhaust gases, if there are any, will smell like Chanel No. 5."

(*Continued on page 74*)

PROGRESS OF OIL DEVELOPMENT IN SOUTHEASTERN GULF COAST STATES

ONE of the most interesting features of the meeting of the Interstate Oil Compact Commission at Jackson, Miss., Dec. 14-16, was a report on the progress of oil search and oil development in the states lying along the Gulf Coast from the Mississippi eastward. Representatives of the geological departments of each of these states reported in detail the most recent activities in survey and exploration within their borders. Within the past fifteen months two of these four states have entered the ranks of oil producing states and in a third important new fields have been opened. The work carried on in these states is representative of the widespread effort now under way in many parts of the United States to locate new sources of oil supply. Because of this fact, as well as because of the significance of the activities reported, a condensation of these papers is presented herewith.

OIL IN ALABAMA

By Stewart Lloyd
Acting State Geologist of Alabama

ALABAMA joined the list of oil producing states on February 15, 1944. A well near Gilbertown, Choctaw County, in southwest Alabama, belonging to the H. L. Hunt Company, came in during that day with a moderate flow of low gravity oil. Up to date nine or ten producers have been found in the same area, and drilling is still proceeding. This makes a short review of Alabama's oil possibilities timely and is the reason for the present sketch.

Stewart Lloyd, Acting State Geologist of Alabama.

First Producing Well in Alabama, Brought in February 15, 1944.

Of Alabama's total area of 53,000 square miles, 35 to 40 thousand may be considered possible oil territory, 25 thousand of these well worth examining for oil, and 10 to 15 thousand quite promising. These are my own ideas and figures and they may not coincide with those of other observers.

We may again divide the possible oil area of Alabama into two parts. The coastal plain which occupies the southern part of the state, both the southwest and the southeast division, has twice the area of the Paleozoics, and starting with the Upper Cretaceous (Tuscaloosa), contains a rather full section from there on up to the very recent formations. The Paleozoics on the other hand include the Warrior Coal Basin, and all of the Tennessee Valley that lies within Alabama. They contain a thick Mississippian section but no Permian.

The thickness of the Coastal Plain sediments runs from zero at the northern outcrop to a known thickness of 12,400 in Clarke County, 90 miles from the Gulf. This depth was reached by a well near Salitpa which bottomed apparently in the Jurassic, though that formation does not outcrop in the state. How deep these sediments go at Mobile and along the Gulf Coast is unknown yet, but assuming the same rate of dip to prevail, without important reversals, we should have at Coden, on the Gulf a thickness of at least 18,000 to 20,000 feet of post Paleozoic sediments. It is worth noting also that salt was struck at the bottom of the Salitpa well, at 12,000 feet.

There has been relatively little drilling in the Coastal Plain of Alabama, up to the present, though holes have been put down intermittently since early in this century. One distinctive and outstanding structure characterizes the whole area, the Hatchetigbee Anticline which extends from the Mississippi line in a southeastern direction for some fifty miles, ending in the north-south Jackson fault. The anticline is 20-25 miles across from northeast to southwest. The Gilbertown oil field just mentioned lies on its northern flank, near the apparent axis, and evidently has some connection with a fault running parallel to that axis.

The details of this large structure, the Hatchetigbee Anticline, recognized now for nearly 100 years, are still not too well known. It is an attractive area for drilling, and is the only obvious large structure to my knowledge in our Coastal Plain. Several smaller ones, not so conspicuous on the geological map, are known and no doubt will receive plenty of attention. It is interesting to note that a magnetometric survey of Southwest Alabama failed to show any sign of the Hatchetigbee structure.

William Clifford Morse, Director Mississippi Geological Survey.

First Producing Well in Mississippi. Standing Beside Well is Frederic F. Mellen, Assistant State Geologist and Discoverer of Tinsley Dome.

Second Commercial Well in the Tinsley Field.

The Tuscaloosa formation, so conspicuous a producer in the Heidelberg field of Mississippi, is now receiving plenty of attention from geologists in Alabama. A large field party of geologists of the United States Geological Survey has established temporary headquarters at the State offices in Tuscaloosa to carry on a program of detailed mapping of this formation throughout Alabama. Watson Monroe is in charge of this work. When completed it should be of real use to those interested in the oil prospects of southern Alabama.

Before leaving the Coastal Plain, a few words about the Gilbertown oil field may be in order. It is some 6-7 miles long, running in a northwest-south direction, and half a mile or so wide. The producing horizon is apparently the top of the Selma Chalk, which is reached here at 2500-2600 feet. One well produces from a greater depth, in the Eutaw. The oil is heavy with a gravity of 17 plus, and the wells are not large producers. Indeed, the total production of the field since last February is only 50,000-60,000 barrels.

The Paleozoic area to the north contains the great Warrior coal basin, and the Tennessee Valley along which Mississippian rocks come to the surface. This is a puzzling district of many ways. Orthodox structures are plentiful; bituminous sandstone and limestone outcrop in many places, and are found below the surface, as well; shows of oil and gas appear in almost every hole; two gas fields have appeared, and have died out after a short life, but no commercial production of oil has occurred. Apparently the sands that might have produced have shown very low porosity. The Fayette gas field which for a year looked like a real field, produced from a dept of 2200 feet in the Pennsylvania.

The western and southwestern margin of the Warrior Coal Basin is made still more puzzling by a thin covering of Coastal Plain rocks, too thin to be themselves producers, but thick enough to obscure the underlying Paleozoics. Surface geology is of no use here, and geophysical methods have to be applied. Drilling is usually difficult in the coal area, but there is little object in going very deep; 3500 to 4000 feet is the probable limit. However, it is impossible for one familiar with the Paleozoic area to avoid the conviction that at least a small oil field will appear somewhere here.

Alabama had the distinction of passing a full sized oil and gas law before producing a barrel of oil. In 1940 the Alabama Legislature passed a law modeled largely on the New Mexico statute. Its object is essentially conservation, and its regulatory provisions are intended to secure that end. It sets up an oil and gas board consisting of the Governor, the Attorney General, and the Director of Conservation, with the State Geologist to administer the law. A drilling permit costing $25 is required, and a bond to ensure compliance with the provisions of the law. A two percent tax is levied on all oil and gas produced and sold. The powers given to the board are broad enough to take care of any contingency, but one interesting clause in the law should be quoted. It is this: "Nothing in this act shall be construed as authorizing the Board to limit the production of any well or pool or field until such time as the total average daily production of the state shall exceed 50,000 barrels per day for a period of 90 consecutive days." We are still a long way from that point. The state legislature meets again in 1945, and it is possible that some changes will then be made in the law. However, it is doubtful that this clause will be deleted.

The State Geological Survey of Tuscaloosa, has one of the finest geological libraries in the country, and a large collection of logs and cuttings from Alabama wells, since the oil and gas law requires them to be deposited with the Survey.

MISSISSIPPI OIL RESOURCES

By William Clifford Morse,

Director Mississippi Geological Survey

IN five short years Mississippi has discovered in addition to the original Tinsley oil field, ten new fields: the Vaughan-Pickens, the Cary, the Cranfield, the Brookhaven, the Flora, the Eucutta, the Heidelberg, the Mallalieu, the Gwinville, and the Baxterville. Before that time she had two gas field; the Amory and the Jackson; and since that time she discovered a new gas field, the Bruinsburg.

The Amory gas field in Monroe County was discovered by H. D. Easton. Its first well, likewise the state's first gas or oil well, was the Amory Petroleum Company's No. 1 Carter, completed in October 1926, at a depth of 2,402 feet, in what was thought to be Paleozoic beds and at an estimated daily flow of 5,000,000 cubic feet of gas. By 1934 the three or four-well field declined to a daily production of only 400,000 cubic feet.

The dome constituting the Jackson gas field of Hinds and Rankin Counties was being determined and described by State Geologist Eugene W. Hilgard, at approximately the same time that Col. E. L. Drake was drilling and completing in 1859 an Oil Creek in Pennsylvania the first oil well of the world. The gas comes from a

depth of some 2,400 feet from the Jackson gas rock which Tom McGlothlin believes to be the approximate time equivalent of the Navarro-Selma (A. A. P. G. 28:45). From its discovery in 1930 the field production rose to a maximum of 15 billion cubic feet in 1939 and declined to a minimum of four billion in 1941, to even two billion in 1942—producing in addition some 15,000 barrels of dead heavy black oil from three wells.

Like the discovery of the Jackson dome, the Tinsley dome was discovered by pure scientific stratigraphic methods by Assistant State Geologist, Frederic F. Mellen, in cooperation with the WPA and the Yazoo City and County Chamber of Commerce. Most of the oil comes from the Selma, from the Woodruff sand, which Tom McGlothlin believes to be a tongue or stringer of the Jackson gas rock (A.A.P.G. 28:45); some of it from the Eutaw; and come from the Tuscaloosa—at depths of the magnitude of 5,000 feet. From its discovery in August 1939, the field production rose to a maximum of 28,000,000 barrels in 1942 and declined to 17,000,000 barrels in 1943—yielding a present cumulated total perhaps of 75,000,000 barrels.

The second oil field in Mississippi, the Pickens, also in Yazoo County, was discovered in 1940. After producing more oil from some three or four wells than could be contained in a saturated reservoir the thickness of the Eutaw sand, C. L. Morgan concluded that drainage was probably from the southeast. The completion of his No. 1 John Whitworth on December 4, 1941, at 4,824 feet, extended the field two miles in that direction and resulted in its designation as the Vaughan-Pickens Oil Field of Yazoo and Madison Counties with a present cumulated production perhaps of 4,000,000 barrels.

The Cary oil field in the Mississippi River flood plain in Sharkey County was, because of the great thickness of alluvium, discovered wholly by geophysical methods by the British American Oil Producing Company. Production since its completion in 1941 is coming from a depth of 3,275 feet in the Cretaceous Jackson gas rock.

The Cranfield faulted structural area in eastern Adams County was described and recommended by Franklin E. Vestal, Geologist of the Mississippi Geological Survey the WPA, the Adams County Board of Supervisors, and the Natchez Association of Commerce, in 1942 (M.G.S. Bulletin 47), a year before the California Company's discovery well, said to have been located by geophysical methods. The number of producing wells has increased to twelve with production coming from a depth of 5,880 feet from the Wilcox, although the initial well showed gas-distillate in the Massive sand of the lower Tuscaloosa formation at a depth of some 10,300 feet. Production has reached a present cumulated total of 280,000 barrels.

The Brookhaven oil field in Lincoln County was discovered by the California Company in July 1943. Production is from one well in the Massive Lower Tuscaloosa sand at a depth of 10,138 to 10,322 feet.

The Flora oil field in Madison County was discovered by the Love Petroleum Company in October 1943. Production is also from one well in the Jackson gas rock of the Upper Cretaceous at a depth of 4,357 to 4,367 feet.

The Eucutta oil field in Wayne County was discovered by the Gulf Refining Company in October 1943 by geophysical methods in a locality of surface evidence with production coming from a sand in the Marine section of the Lower Tuscalooosa at a depth of 6,660 to 6,672 feet. To date some 20 wells having a present total cumulative production of 172,000 barrels, have been drilled.

The Heidelberg oil field in Jasper County was drilled by the Gulf Refining Company in January 1944 on geophysical evidence in an area revealing a surface structure. Although the initial well was drilled to 6,578 feet it was completed at 4,958 to 4,968 feet in the basal Eutaw. To date 46 wells have been drilled, producing 588,000 barrels.

The Mallalieu oil field in Lincoln County was discovered by the California Company in August 1944. Production is coming from the Massive sand of the Lower Tuscaloosa at a depth of 10,522 to 10,558 feet. To date two wells have been completed.

The Gwinville gas and distillate field in Jeff Davis County was discovered by S. W. Richardson in August 1944. Production is from three perforations at 7,855-7,880, 8,075-8,106, and 8,120-8,132, from the Lower Eutaw and Upper Tuscaloosa. On November 30, 1944, two other wells were being tested or completed; one showing oil at 9,218 to 9,253 feet in the Massive sand of the Lower Tuscaloosa, the other testing gas distillate in the Eutaw and Tuscaloosa sands.

The Baxterville oil field in Lamar County seems to be assured by the Gulf Refining Company No. 1 C. V. Cooper. Production is from 8,690-8,714 and 8,734-8,744 feet from the Massive sand of the basal Tuscaloosa.

Of the 22 salt domes in Mississippi, the Bruinsburg salt dome in Claiborne County was estimated on November 22, 1944, to yield five million cubic feet of gas from the Moody's Branch member of the basal Jackson and from the top of the next lower formation, the Cockfield, at a depth of 935 to 945 feet. Thus Mississippi has her first production of either gas or oil from a shallow piercement type salt dome. Obviously the other 21 salt domes will receive attention at an early date.

In addition to the two original gas fields and the three original oil fields, Mississippi in two years, has discovered eight new oil fields and one new gas field. Accordingly, from the consideration of the rapid decline of oil production in the unconsolidated rocks of some of the Gulf Coastal fields, of the arbitrary stand of potentially the most powerful nation on earth, of the compelling waste of oil in the war effort, it would seem imperative that Mississippi, and other oil and gas producing states for that matter, look to the future supply of oil with a jealous eye. Without oil, this nation will be largely at the mercy of the nation that has husbanded her petroleum resources.

PROSPECTING FOR OIL AND GAS IN GEORGIA

By Garland Peyton

Director, Georgia Department of Mines, Mining and Geology

THE entire width of the belt of crystalline rocks of the older Appalachians is found in Georgia. These rocks occur north of the Fall Line where they consist of granites and highly metamorphosed ancient sedimentary formations. In the northwestern part of the state the entire width of the folded Appalachians is exposed in the northwestern counties, and outliers of the Cumberland Plateau occur in Dade and Walker counties. A few test wells have been drilled in the Paleozoic area near Rome in Floyd County, but there is little to encourage hope for the discovery of oil in this section.

The Coastal Plain of Georgia composes nearly one-half the area of the state. The rocks underlying this surface range from Cretaceous to the present. Interest in prospecting for oil and gas in our Coastal Plain reached an unprecedented peak during the year 1944. This is true from the angle of leasing, geophysical prospecting, and wildcat drilling.

The total acreage leased by persons interested in prospecting for oil and gas in the Coastal Plain of Georgia, as of October 1, 1944, was upwards of nine million acres. This acreage is held in the main by approximately a dozen of the major oil companies, with smaller holdings by some of the larger independent producers and certain syndicates or groups of individuals. Two years ago the average annual rental paid for leases amounted to from five to fifteen cents per acre. During the present year, these figures have doubled and in some instances have reached as much as 50 cents per acre. In addition to leasing, there has been considerable dealing in royalties, —in most cases by outright purchase of one-half the owner's royalty interest. Information available indicates that the prices paid for such royalty interest ranged from 50 cents per acre to as much as $2.00 per acre, depending on the location of the acreage and the opinion held by the

Garland Peyton, Director, Georgia Department of Mines, Mining and Geology.

Derrick Used on California Company's Test Well in Wayne County, Georgia.

purchaser regarding the potentialities of such acreage.

A number of larger companies, including the California, Humble, Sun and Hunt Oil and Gas Company, have kept geophysical crews of one type or another busy throughout the year on their respective holdings. Officially in some instances, and unofficially in most cases, it is understood that results of these geophysical surveys have made possible the selection of sites offering greatest promise for wildcat drilling. It is understood that all of these sites will be drilled as early as may be practicable; some companies are drilling at present, while others will have to await the end of the present war in order to obtain sufficient labor with which to operate.

Although spasmodic, ineffectual efforts to prospect for oil and gas in the Coastal Plain of Georgia have been made at various times during the past 30 or 35 years, it was not until 1938 that the first adequate test was made with a rotary rig. During that year the Pan American Exploration Company drilled a wildcat well near Offerman in Pierce County, Georgia. This test was a dry hole and reached granite at a depth of 4375 feet. A few months later a second hole was drilled about two miles from the site of the first one. This second well also was a dry hole and reached granite at a depth of 4355 feet.

In 1938 and 1939 shallow tests were made west of the Okefenokee Swamp in Clinch County and north of Pierce County in Montgomery County. Showings of gas and oil were obtained from wells in both these localities. Two horizons yielded showings in Clinch County, one at approximately 400 feet and the other between 900 and a thousand feet. Showings in Montgomery County were at a depth of approximately one thousand feet.

On December 24, 1941, a deep well was spudded in about seven miles from Albany in Dougherty County, Georgia. This well was suspended early in 1942 after reaching a depth of 5012 feet. It did not reach crystalline rock, however. A second well was drilled about 17 miles south of Albany immediately after completion of the first well. This second well reached a reported depth of 5300 feet without reaching crystalline rock. It was understood that neither well showed much promise of commercial oil or gas. The surprising thickness of the sedimentary rocks encountered in these two wells was both interesting and encouraging.

During 1943 William B. Hinton of Texas selected a site 15 miles west of Donaldsonville in Early County, southwest Georgia, and drilled what up to that time was the deepest well ever drilled in Georgia. This well reached a depth of 7320 feet. The well suspended drilling before reaching crystalline rock in what has been identified tentatively as very hard quartzite, probably Paleozoic. In addition to the Early County well, one well was started at a point seven miles northeast of Douglas in Coffee County but suspended drilling at a depth of 1200 feet because of difficulties encountered in cavernous limestone formation. Also a well was started east of Coffee County in Wayne County and suspended operation at 1900 feet. This was the well in which a reported showing of oil was announced by Drew Pearson over the radio. To date we have been unable to verify this reported showing.

During 1944 Hassie Hunt, of Hunt Oil & Gas Company, drilled two wells in Clinch County, one 15 miles southeast of Homerville and the other five miles southeast of Homerville. These wells while drilling "tight", are reported to have reached depths of 4250 feet and 3400 feet, respectively. The former is supposed to have encountered crystalline basement rock. Following the completion of the two wells in Clinch

County, Hunt moved his rig six miles south of Bainbridge in Decatur County and drilled a well to a reported depth of 261 feet, where drilling was suspended on account of a large cavity at that depth. From this location Hassie Hunt moved to Echols County south and southwest of Clinch County, where his fourth well during the present year was completed on or about October 10. It is understood that Hunt will now move his rig to Atkinson County, where his fifth well will be spudded in within the next few days.

The deepest well drilled in Georgia to date was the J. H. Pullen No. 1 well, 5½ miles east of Pelham, Mitchell County, Georgia. This well was started on May 27, 1944, was completed August 14, 1944. Drilling was suspended at a depth of 7487 feet in what was reportedly identified as Triassic diabase rock. A thin section of a fragment of what was at first understood to be the bottom sample identified the rock as sandstone. Since that time, however, information has reached us to the effect that a cut of the final bottom sample was not made available to us. Also we have heard that those who did examine the final sample identified it as crystalline rock. In any event this Pelham well has furnished much interesting information, which, when considered with the results from the Early County well appears to suggest the possibility of finding still greater thickness of sedimentary formations in southwest Georgia.

According to announced plans of the different individuals and companies interested in drilling, additional wells will be drilled within the next few months in a number of counties throughout the Coastal Plain of Georgia, including Atkinson, Worth, Lowndes, Crady, Montgomery, Laurens, Wayne, and several of the counties bordering on the Atlantic Ocean.

Summarizing the work thus far performed in an effort to discover commercial gas and oil in the Coastal Plain of Georgia, it appears that our thinnest section of sedimentary formation overlies what may be a granite ridge extending from Echols County near the Florida line northeastward through Clinch and Pierce counties toward the South Carolina line. Here sediments may not be in excess of 5000 feet. There is evidence that these sedimentary formations increase in thickness to the south and southeast and to the west and northwest. To the south formations have been encountered at a depth of approximately 5,000 feet, which were identified as Pennsylvanian or Mississippian. Going westward from a line drawn through Clinch and Pierce counties, we find progressive thickening of sediments to more than 7,400 feet in Mitchell County and more than 5,300 feet in Dougherty County. These promising findings, together with commercial discoveries of petroleum to the west of us in Alabama and to the south of us in Florida tend to encourage the belief that it will be only a matter of time and the opportunity to drill a sufficient number of wells before commercial discoveries are made in Georgia.

Herman Gunter, Director Florida Geological Survey.

FLORIDA GEOLOGY AND PETROLEUM

By Herman Gunter
Director, Florida Geological Survey

AS a petroleum producing state Florida is not the youngest. I believe that as a producer Alabama is about four months younger than we are, but even so the discovery of oil in Florida is rather recent. In fact, it is very surprisingly recent when one considers that the first wildcat in Florida was drilled forty-three years ago. Back in 1901, two test wells were drilled in Escambia County, which is the most western of the counties in the Florida panhandle. One of these reached 1620 feet and the other was carried down a hundred feet deeper. Two years later a wildcat was drilled to 2002 feet in North central peninsular Florida, and in 1905 someone tried Escambia County again with a 1435-foot hole. After that the wildcatters were discouraged and for twelve years they did not disturb Florida. In 1917 they returned, and from that year until 1939 they drilled seventy-three tests. These seventy-three tests were fairly well distributed throughout the state so that laterally the state had been rather thoroughly prospected by 1939. And yet nothing more than a few questionable shows had turned up to reward all this enterprise. It was a little discouraging. Something was wrong, and it began to look as if that something might be the absence of petroleum in Florida.

Then in 1939 the Peninsular Oil and Refining Company drilled their J. W. Cory No. 1 well in Monroe County, in the southernmost part of the Peninsula. Like all the others it turned out to be a dry hole. But in another way, the Cory was not like any other well that had been drilled in Florida. It was the first well to do a good job of exploration in the third dimension, that is, depth. It was abandoned at 10,006 feet, which was nearly 4000 feet deeper than the deepest well previously drilled in Florida. Going back to the records, we find that the deepest of the 73 wells drilled prior to 1939 was abandoned at 6180 feet, that out of the 73, only five went below 5000 feet, while the majority were given up as bad jobs at less than 3000 feet. In other words, all those wells had hardly more than scratched the surface of Florida geology.

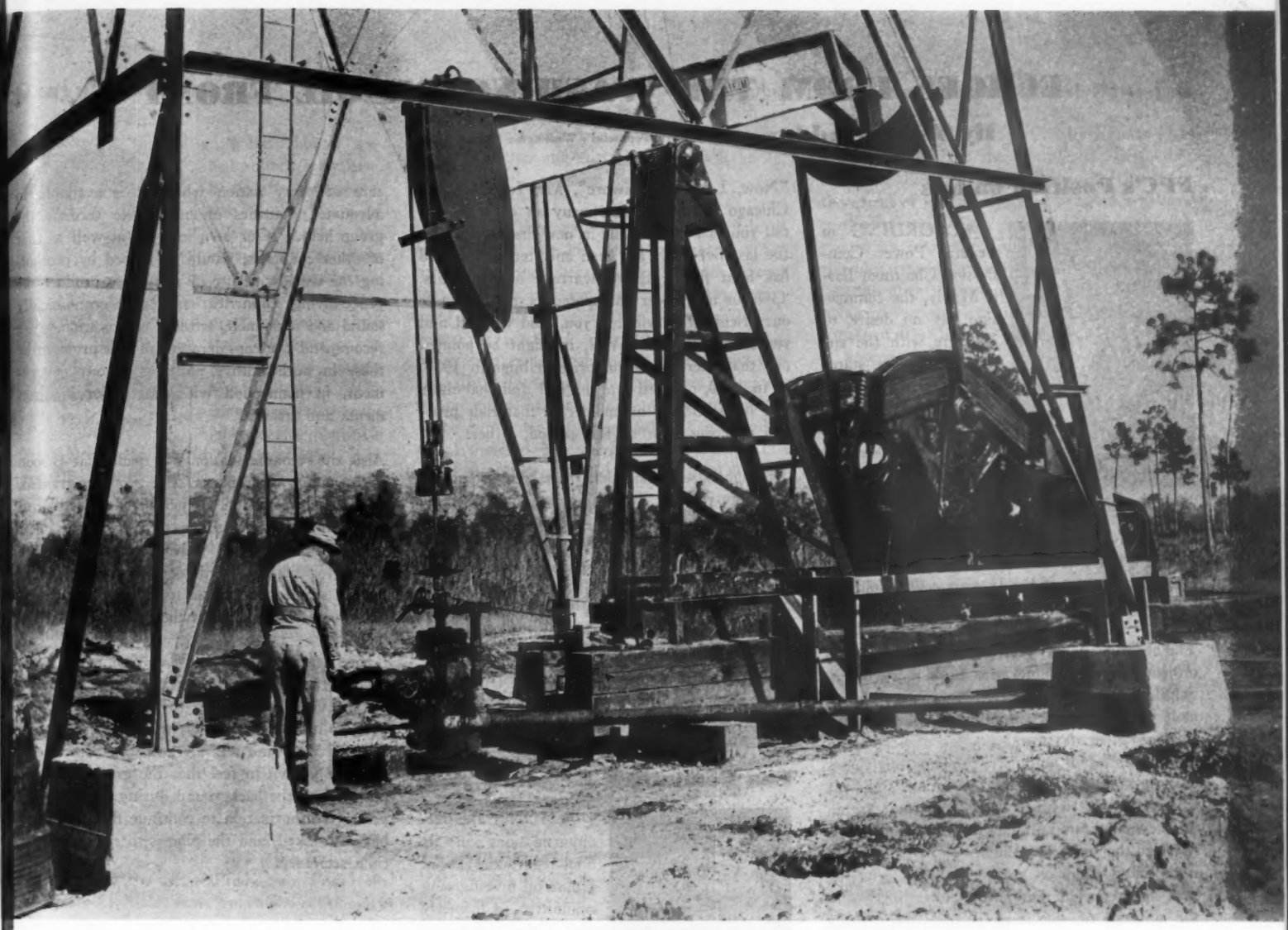
In the three years following the drilling of the Cory well, only two wildcats were drilled and the deepest of these reached no greater depth than 6017 feet.

In 1943 there was a boom in wildcatting; eight wells were drilled. Seven of these were abandoned at less than 3000 feet. But the people drilling the eighth well had a different idea. They were thinking in three dimensions. They did not give up until they had reached a depth of 11,626 feet, and by that time they had a producing well, the first in Florida. That was Humble's Sunniland No. 1 in Collier County in the south Peninsula.

Summing it up we have something like this: In 42 years of prospecting in Florida, 91 tests were drilled. Of the 91 drilled, 89 were abandoned at depths of less than 6200 feet, and most of them at less than 3000 feet. The remaining two wells were carried down to 10,000 feet or more, and of these two, the deepest found commercial production. Looked at in this way, the history of prospecting in Florida is not so discouraging.

Now please do not understand me as saying that to get oil in Florida all you have to do is to drill to about 12,000 feet. What I do mean is that although Florida has been very well explored laterally, only a mere beginning has been made in exploration in depth. To the prospector who is prepared to drill deep holes, Florida may be looked upon as practically untested territory.

As producers in other states go Sunniland No. 1 is not very remarkable, but we in Florida think a good deal of it because it is our first, and so far, our only oil well. Initial production on the pump was a little over 100 barrels a day of black asphaltic base oil of 20° gravity. From the start, salt water was produced with the oil and there was more or less emulsion that required treatment. The well yields some gas;



Sunniland No. 1—Florida's Only Producing Well in Operation.

enough to run the pump and treater, but there is hardly enough left for anything else. During the first six months the production declined rapidly to about thirty barrels of oil a day, while the proportion of salt water in the fluid pumped increased to 90 percent. Since March of this year production has been fairly steady, averaging about thirty barrels a day. Total production to date is approximately 12,000 barrels.

But even if the production at Sunniland is not much of a contribution to the nation's petroleum supply, it is important in its implications. For one thing, it answers the important question of whether or not there are petroleum source beds in Florida with a definite "yes". Apparently a number of major petroleum companies believe that the discovery has significance. As a consequence, there has been some fairly intensive prospecting in the state during the past year. At present six wells are being drilled. Of these, five are in the South Peninsula, that is, in the general region of the Sunniland well. One of these is below 10,000 feet, and with one exception, the others are planned to go to comparable depths. The sixth active well is in the Panhandle. In addition, three locations have been made and drilling on at least one of these will commence in the near future. These locations are also in the southern Peninsula.

Then there have been two completions since the announcement of the discovery at Sunniland. One of these was in Leon County, which is just about where the Panhandle begins. It was abandoned at 6520 feet. The other was drilled one mile west of the discovery well. It reached a depth of 13,512 feet, without obtaining production, a thing which casts somewhat of a shadow upon the hope of developing much of a pool at Sunniland. Recently the Humble Company has moved the rig to a new location one mile to the north of the discovery well and is making preparations to test the same horizon again.

In addition to this drilling, there has been a good deal of geophysical work done during the last year. So much, in fact, that one can hardly go anywhere in the state without finding tags and strips of flaggine dangling from bushes and trees along the roads which have been traversed by geophysical crews. The reflection seismograph, magnetometer, and gravity meter have been used. An absence of marked lithological discontinuities in the stratigraphic column of Florida, particularly in the deep zones, has made work with the reflection seismograph rather difficult. With the magnetometer and gravity meter there has been the usual difficulty of interpreting the data in a region where the subsurface is so little known through deep drilling. Recently a refraction seismograph survey has been completed with what appears to be reasonably sastifactory interpretations.

Because of these difficulties with geophysical methods, drilling for structure has been restored to rather extensively. But even with this tool, the way of the prospector in Florida is hard. Some of the widely distributed limestones are so porous and permeable that it is often impossible to maintain circulation and thereby obtain cuttings. Consequently, it is necessary to take cores to a much greater extent than in most other states.

One more good measure of the interest that oil men are taking in the state is leasing activity. At the present time fully five-sevenths of the land area of Florida is under oil and gas exploration leases.

ECHOES FROM THE WASHINGTON OIL FRONT

By W. J. Maddox, Chief of World Petroleum's Washington Bureau

FPC's Position on Gas

Basil Manly

ACCORDING to Federal Power Commission Chairman Basil Manly, the commission has no desire to interfere with the authority of the states in either production or local distribution of natural gas. In an attempt to clear up some apprehensions as to FPC's forthcoming hearings on natural gas, Manly recently explained the agency's position in a letter to Governor A. J. Schoeppel, of Kansas, chairman of the Interstate Oil Compact Commission.

The hearings, Manly said, are designed to obtain information in "dealing with conflicting contentions" as to authority of the Commission to promote conservation by limiting or prohibiting the transportation of natural gas for "'so-called inferior uses" and authority to deny certificates to take natural gas for interstate shipment from states that wish to retain and use it within their own borders. An FPC representative who attended the recent meeting of the Interstate Oil Compact Commission at Jackson, Miss., Manly said, had reported that misunderstandings as to the purpose of the investigation were "being stimulated by representatives of oil and gas companies."

There has been a feeling in some quarters that federal control of natural gas production might be an opening to regulation of crude production. FPC's moves in this direction, therefore, are being closely watched. Secretary of Interior Ickes wants to know if "conservation" applies to production or to end use. If it applies to the former, then he feels that the states have enough jurisdiction. FPC takes the stand that under the Natural Gas Act it has authority to make any investigation it finds necessary for recommending further legislation to Congress.

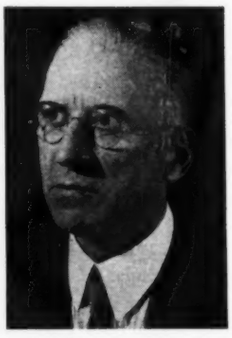
Ickes On Oil Search

PETROLEUM ADMINISTRATOR ICKES appears to have lost some of his former confidence that an overall boost in crude prices would bring in more discoveries. Some sections of the industry are putting their finger on the following paragraph from his recent speech in Chicago and checking it against some of his statements made at the time he was pressing the Price Administration for an average 35-cent-a barrel hike.

"Now, I am quite aware", Mr. Ickes told his Chicago audience, "that many an oil man will tell you that this decline in new discoveries over the last five years has been only temporary, and has been the result of wartime abnormalities. 'Give us manpower and materials, and unfreeze our prices,' they will tell you, 'and we will find you plenty of oil.' Well, it might be pointed out that there were no price ceilings in 1939, or in 1940, or until late in 1941 and that there was no particular manpower or materials problem covering most of this period, either.

"It might also be said that there have been more exploratory wells drilled during the last three years—in spite of scarcity of materials and manpower and controlled price—than ever before in our history. But let us overlook that. The fact remains that looking for oil does not mean finding it, and every oil man knows it. And so, even though I hope with every oil man that the unfavorable trend of the last five years will, in fact, be found to be only temporary, I don't know that it will, and neither does anyone else."

Lea Committee Resumes



Clarence Lea

AMONG the recommendations in its final report, the special House oil investigating committee — formerly the Cole committee and now headed by Representative Clarence Lea of California—threw out several ideas that may soon be pointed up in legislation to be submitted to Congress. Among the matters that the group thought should be given "legislative attention by Congress" is the practice of the Bureau of Internal Revenue in treating certain geological and geophysical expenditures as capitalization instead of allowing them to be charged off as expenses, as was the practice in the past. The committee held that this "retards production of oil."

In order to offset the deficiency in discovery rate, the committee said, "industry must be further induced to make additional expansions". PAW has held that the Bureau of Internal Revenue's interpretation was not required, is a reversal of a prior, long-standing interpretation, and has held back exploratory operations at a time when they are essential.

The committee came out in favor of an international oil pact. "Oil raises the economic welfare of every nation where it is available in adequate quantities on reasonable terms", the group held. "Our own interest, as well as that of other countries, would be helped by promoting the worldwide use of petroleum products by peace-loving countries on terms economically sound and reasonable, without exploitation. We recommend the consideration of this problem by those in authoritative positions in our government, in connection with international agreements and treaties."

Also, the recommendation was made that as soon as "necessary clearances can be properly granted, oil industry personnel be permitted to return to liberated areas in Europe to rehabilitate vital petroleum facilities." The committee further called for lifting "burdensome routine and delays in securing materials for foreign operations and the license to export the same."

There are indications the Lea committee is going to take a more active part in oil matters on the Hill—an attempt to regain some of the prestige it held in the days when Representative Cole of Maryland was at the helm. Some members are known to feel that the group has been pushed into the background during the past two years. Authorization to continue the committee has been asked, and the plan is to engage a full-time secretary.

Military Use in U. S.

TOTAL petroleum consumption (exclusive of aviation products) by the Army in the United States averaged 72,420 barrels a day during the six months April to September 1944 inclusive, says the Fuels and Lubricants Division, Office of the Quartermaster General. Consumption figures for the Army in overseas theaters of war are not released.

A break-down of the daily continental consumption for the period reveals that the Army used 2,680 barrels of 80-octane gasoline; 29,140 of other gasoline; 1,430 of kerosene and solvents; 3,040 of Diesel fuel oil; 6,780 of other distillate fuel oils; 25,810 of residual fuel oils; 1,790 of lube oils and greases; 1,270 of asphalts; and 480 of all other products.

These rates of consumption were not expected to change materially during the remainder of 1944 except for increases in fuel oils for heating. The seasonal increase in fuel oils, the Army says, may have raised the distillate consumption rate to about 17,500 barrels a day and the residual consumption to about 35,100 barrels a day during the winter months.

Guayule Rubber

T. A. Poage

THE house special rubber committee, headed by Representative T. A. Poage of Texas, wants the government to turn guayule production over to private enterprise but to continue its experiments in growing and processing the plant. The committee believes the latex-bearing plant can be produced profitably in this country and suggests that in order to establish " a sound postwar industry in private hands" the government should establish and guarantee for from seven to ten years a floor under the price of domestically produced guayule rubber.

"We believe this floor should be somewhere between 20 and 50 cents a pound of rubber content," the committee says. "Probably it should be fixed at the established price of 28 cents a pound. It should be offered for a definite acreage only so as to prevent any undue drain on the Treasury if the cost of production is reduced as low as we hope it may be by quantity production."

As to the suitability of guayule rubber the committee pointed out that the B. F. Goodrich Company advised the War Production Board on November 21, 1944, that "guayule is satisfactory as a 100 percent replacement for other rubber in the outer carcass plies of heavy duty, S-4 tires."

Romanian Refining

STATE DEPARTMENT officials are inclined to play down the value of equipment and machinery that Russia is understood to have removed from the Romanian oil fields. Although the Russians have given no complete explanation as to amount and type of material removed, they have assured the United States and British interests in the captured fields that their rights are being respected and that the fields will be developed for the common war good.

Officials in this country admit that little is known about what has been taking place in Romania since the liberation of the fields, except that the Russians have shipped out some equipment and machinery. United States and British companies produced some 65 percent of Romanian's prewar production of 6,000,000 tons annually. Bombing attacks by Allied planes destroyed much of the refining equipment and reduced output by more than half. Enough additional material has been taken to Russia, it is reported, to cause a further big drop in production.

Elks Hills Output Rising

STANDARD OF CALIFORNIA estimates that its production in the Elk Hills Naval Reserve will reach the 65,000-barrel-a-day goal substantially in advance of June 30, the deadline set by Navy in its unit-plan operating contract. Output of the reserve now exceeds 44,000 barrels a day, which places production well ahead of schedule to date.

Since the first well authorized by the program was spudded in during June 1944, 117 wells have been completed. All of their output is from shallow zones—approximately 3,000 feet. Average daily production is better than 200 barrels a day. Nineteen contract drilling strings are now working in the field. Monthly totals of well completions have been: July, 4; August, 10; September, 16; October, 27; November, 27; and December, 33. The complete program is expected to total approximately 250 wells. Under the unit operating agreement, Standard is getting 15,000 barrels daily, with the remainder being sold by Navy to the highest bidder.

Darlington Heads Oil Division

APPOINTMENT of Charles Francis Darlington as chief of the Petroleum Division of the State Department results in no change in the status of Charles Rayner, petroleum advisor to the Secretary. Also, responsibilities of the Division are unaffected in the reorganization of the Department by Secretary Stettinius. It still has the duty of formulating and co-ordinating policy in foreign petroleum matters, and remains a part of the Office of Economic Affairs, which is headed by the new assistant secretary Will Clayton, former Reconstruction Finance Corporation official.

Since June Mr. Darlington has been special assistant to Mr. Stettinius, then Undersecretary of State. He is on leave from Columbia University, where he is a member of the faculty. He was in Washington with Lend-Lease in 1941, and later saw service in the Navy.

Coleman Leaves PAW

Stewart P. Coleman

STEWART P. COLEMAN has resigned from his post as director of the program division of PAW to resume his duties as head of the Economics Department of Standard Oil Company (N. J.) Mr. Coleman was called to Washington to organize the program division when it was first established in 1942 for the purpose of determining available sources of oil supply for war use by the United Nations. He is succeeded as head of the division by Howard W. Page who has been assistant director. Jerry A. Cogan who has been an assistant is named as associate director and will give special attention to questions of foreign supply.

Following his participation in the recent international business conference at Rye, N. Y., where he headed the Iraq delegation, Said Hafidh Al-Kadi traveled to Detroit to discuss postwar business prospects with officials of the Norge division of Borg-Warner Corp. He is Norge distributor in Iraq and Iran and is shown here with M. G. O'Harra, Norge vice-president in charge of sales, R. W. Gifford, Norge vice-president and assistant general manager and Arch Black, export manager.

Oil Company Staff Changes

DANIEL PYZEL, veteran oil man and leader in the development of oil industry research, has retired from his position as vice president and director of Shell Union Oil Company after forty seven years of active service in the petroleum field.

He was born in Amersfoort, Holland, in 1877, and upon graduation from the Technical University at Delft in 1897, gained his first field experience in the oil fields and refineries of Galicia. During the nine years following he was located in Java and Sumatra designing and erecting refineries. In 1906 he became associated with the Shell Group of companies and founded an engineering staff to design refineries, which later was to serve as the basis for Shell's extensive engineering activities. In 1907 he returned to the East Indies to erect a refinery and paraffin wax and lubricants plant on the east coast of Borneo. This was the first time that crude oil from the wells of this island was used as basis for the production of these materials.

In 1911 Mr. Pyzel was put in charge of planning refinery construction and spent the next several years in traveling to inspect Shell properties and in supervising the construction of plants in the United States including the great Wood River refinery. He became deeply interested in cracking of petroleum molecules, a process which at that time was a revolutionary development, and in 1919 he completed an agreement whereby Shell became the first licensee of the famous Dubbs cracking process. In addition to his active interest in installing the process in Shell refineries, Mr. Pyzel did much to add to its development and make it acceptable for practical application.

Mr. Pyzel's interest in cracking processes and in the gases which resulted from cracking resulted in the organization of the Shell Development Company in 1928. From the research into petroleum chemistry conducted in its laboratories at Emeryville, California, came the first successful and practical method of producing butadiene used in the manufacture of synthetic rubber, and the development of nitration grade toluene. This same research made possible the delivery of the first 100 octane gasoline to the U. S. Army Air Corps in 1934. In addition, the company also developed many other petroleum products, such as Navy turbo oil, rust preventatives and insecticides, which have found many wartime applications.

In 1937 Mr. Pyzel left the Pacific coast to come to New York to assume the vice presidency in charge of research of Shell Union. Since that time he has directed the company's activities in the research, development and chemical fields, and has been in charge of negotiations concerning patents and processes in the sphere of research and development. The vacancy created on the board of directors by his retirement has been filled by Gayer G. Dominick, senior partner of the investment banking firm of Dominick and Dominick.

CLARENCE H. LIEB, associated for many years with producing activities of Standard Oil Company (New Jersey) and president of its affiliate, Creole Petroleum Corporation, died on Dec. 30 at Good Samaritan Hospital, West Palm Beach, Florida, after a brief illness. Mr. Lieb, who was 50, had gone to Delray Beach for a vacation.

During 27 years Mr. Lieb helped to develop the production of crude oil in the mid-continent area of United States, in Mexico, and in Venezuela where the Creole company operates.

He was born in 1894 in Roaring Branch, Pa., and attended Pennsylvania State College, graduating in 1916 with a BS degree in engineering. Shortly thereafter he joined The Carter Oil Company as draftsman and engineer in its eastern division. Two years later he was transferred to Mexico to supervise a construction project for the Compania Transcontinental de Petroleo, S. A. at Vera Cruz. The following year he was made superintendent of construction and supervisor of transportation for the company in its south Mexico fields, and in 1926 he was named president and general manager with headquarters at Tampico.

In 1928, Mr. Lieb was transferred to Standard's Venezuelan interests, as vice president of Creole Petroleum Corporation and president of Standard Oil Company of Venezuela which was later absorbed by the former company. With headquarters at Caripito, he was in charge of all Venezuelan producing activities of Standard Oil Company (New Jersey).

Four years later he was recalled to the U. S. to become president of The Carter Oil Company at Tulsa, Okla. and in 1938 he was transferred to New York to coordinate producing activities for the Standard Oil Company (New Jersey) oganization. In 1941 he was elected president of the Creole company. Mr. Lieb was chairman of the Producing Sub-Committee of the Caribbean Area Petroleum Committee of the Petroleum Administration for War.

He was married in 1932 to Mrs. Letitia McClintock. He is survived by his widow, a foster son, John McClintock Lieb, 21, who is with the U. S. Army overseas, and a son, Frederick, 9.

F. B. BIMEL, who has been associated with the producing and pipeline end of the oil industry during a business career of forty years, has been elected a vice-president of International Petroleum Co., Ltd. In 1904 he joined the Prairie Oil and Gas Company in Kansas City as general foreman of pipeline construction, and superintended the laying of the first pipeline east from the mid-continent field. Following the line as it moved east, he was transferred to the Ohio Oil Co. and later to the Illinois Pipe Line Company.

On completion of the line to Bayway, N. J., Mr. Bimel joined Standard Oil of Louisiana in 1909. In 1915 he was made producing assistant in the Caddo field in northern Louisiana, three years later taking charge of the gasoline department. Transferred to Standard Oil Co. (N. J.) in 1922, he organized a system of recovery of light ends which played an important part in the oil industry's conservation program. He joined International Petroleum as a director in 1928.

Daniel Pyzel

Clarence H. Lieb

AMOS BALL, a director of Standard Oil Company (Indiana) and vice president in charge of sales, retired on January 1, after forty-eight years of service with the company. As a result of his retirement Roy F. McConnell, who has been manager of sales, succeeds to the vice presidency; H. E. Hanson becomes general manager of sales; R. F. Baity is made assistant general manager; J. W. Honomichl is transferred from Des Moines to Chicago as assistant sales manager for the central division; R. T. Kinnerman goes to the Des Moines post from LaCrosse, Wis.; D. J. Byers moves from St. Louis to be manager at LaCrosse, and H. L. Poole is transferred from the home office to be assistant manager at St. Louis.

ADAM H. SMITH has been appointed sales manager of the Richfield Oil Corporation of New York. For the past 32 years, Mr. Smith has been associated with the interests of independent petroleum marketers. With Richfield he served first as salesman in eastern New York State, later becoming district manager of the New England territory from which post he now moves to Richfield's New York headquarters.

W. H. ZABRISKIE has been named manager of the industrial relations department of the Socony-Vacuum Oil Company Inc., succeeding C. R. Dooley, who has retired. Mr. Dooley was given a leave of absence four years ago to join the War Manpower Commission, for which he is now Director of Training Within Industry. Mr. Zabriskie has been with the Socony-Vacuum for thirty years, starting with the Devoe Works, Long Island City, after he graduated from Cornell University with degree of M.E. In 1925 he was made superintendent of the Devoe Works and in 1930 joined the industrial relations department of the company.

W. A. WATKINS, who has been superintendent of the southern division of Carter Oil Company, has been appointed general superintendent of production with offices in Tulsa. He succeeds Ralph E. Damp, who goes to Havana, Cuba, as director of the Standard Oil Company of Cuba, in charge of drilling and exploration.

Other changes announced by President Schorp of Carter include the transfer of F. W. Bruner, from Billings, Montana, to Shreveport, La. as manager of the southern division, succeeding Mr. Watkins; R. B. Curran, formerly assistant division manager of the northwest division with headquarters at Billings, becomes division manager; John Campbell, formerly assistant supervisor of petroleum transporation, becomes special assistant to M. A. Wright, assistant manager of the Carter production department, in Tulsa; Phil Cochran, formerly division geologist of the southern division, becomes assistant superintendent of the southern division and R. W. Beck, assistant division geologist at Shreveport, has been named division geologist.

J. A. Miller

J. A. MILLER, formerly advertising sales promotion manager of Esso Marketers, has been appointed to the newly created position of coordinator of the domestic and foreign advertising and sales promotion activities of Standard Oil Company (N.J.)

W. W. WELLS, secretary of the Product Conservation Committee of the Petroleum Industry War Council and promotion manager of the industry's campaign against the black market, has resigned to resume business in the advertising and public relations field.

G. F. GEPHART has been promoted from assistant comptroller to comptroller of Standard Oil Company of California. This position has been held by B. W. Letcher, who is also a vice president and the secretary of the company.

PARKER S. WISE has been made supervisor of the harbor and inland waterway division of Socony-Vacuum Oil Company Inc., succeeding Charles E. Heyl, who is retiring after 42 years of service. Mr. Wise joinded the Marine Department of the Company in 1929 after being graduated from Harvard.

PHILLIPPS PETROLEUM COMPANY, Bartlesville, Oklahoma, announces formation of the engineering and equipment division of Chemical Products Department with O. L. Garretson as manager. This division will handle equipment and appliance development, tests, and engineering.

J. C. Chatfield has been promoted from assistant manager to manager of the products supply division which handles liquefied petroleum gas, solvent, and special product supply, transportation and other shipping matters for Chemical Products Department.

R. M. Gray

R. M. GRAY is the newly appointed director of advertising and sales promotion for Esso Marketers, having been advanced from the position of assistant manager. The activities of Esso Marketers cover the sales operations of Colonial Beacon Oil Company, Standard Oil Company of New Jersey and Standard Oil Company of Pennsylvania with territory extending from Maine to Louisiana.

SEQUOYAH BROWN has resigned his position as assistant manager of the personnel and industrial relations department of Carter Oil Company. He will head a similar department with the newly organized Interstate Oil Pipe Line Company.

G. L. ADAMS has been named as manager of General Petroleum Corporation's laboratories following the retirement of the company's former laboratory chief, G. F. Olsen, Sr.

Adams has been with General Petroleum since 1925 and has served as assistant manager of the laboratory department since 1941. He is chairman of the Aviation Gasoline Committee for District No. 5, Petroleum Administration for War, and at one time was an instructor at Michigan College of Mines. He holds twelve patents ranging from crude dehydration to various refining processes.

Olsen's retirement marks the windup of a colorful career in the petroleum industry. In the last war he served as refining consultant to the Navy and State departments. He joined General Petroleum Corporation in 1925 and became laboratory chief in 1932. With his retirement he also relinquishes his duties as a director of the company.

J. A. Boege, who has been with the company since 1930, has been appointed general superintendent of laboratories, reporting directly to Adams.

Foreign Oil Legion

Left to Right: Lt. Col. Emmett M. Donovan, formerly with Burmah Oil Co. at Digboi Upper Assam; M. H. Bush, Now With the American Overseas Petroleum Company, Egypt. Recently Returned from a Mission With the Kansu Oil Mining Administration, Chungking, China; Dr. W. L. Lee, Chinese Representative — Visiting Oil Men, Guests of California Nomads.

GEO. W. WOLF, president of the United States Steel Export Company has announced the appointment of Eugene J. Brinkman as the company's special representative to act as consultant in the promotion of customer relations and in the development of all phases of the company's business in Colombia, Venezuela and Panama.

Mr. Brinkman has been engaged in the steel export business for the past twenty-four years, having joined the company in January, 1920. He has held various positions and for a time was manager of the company's offices at Havana, Cuba. Later he became the administrator of Cubacero, located in Havana. Recently Mr. Brinkman has acted as lend-lease coordinator for the company with headquarters in Washington.

Mr. Brinkman will establish headquarters in Bogota, Colombia, and plans to make frequent trips throughout Colombia, Venezuela, and Panama to keep in close contact with all steel-consuming customers.

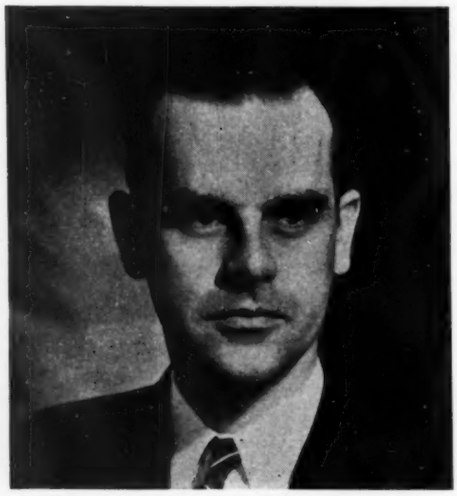
R. L. (BOB) GOLLUM of Security Engineering Company left Los Angeles last month on a six months trip to South America which will cover all the major oil fields of the northern part of that continent.

Mr. Gollum, who has represented the export division of Security, both in California and New York, will take to South American operators the latest information on the company's line of oil tools and also on the Crum-Brainard roller bit since Security recently bought out the Crum-Brainard Company. Proceeding by plane through Mexico City and Balboa his first extensive stop is Maracaibo where he will visit the fields of the Lake district, going thence via Caracas and Barcelona to the eastern Venezuelan field. Early in March he will arrive in Trinidad and after covering that island will return by way of Maracaibo to Colombia. The next two months will be spent in visiting the fields of Colombia, Ecuador and Peru, returning to the home office in June.

AT the January business meeting of the Los Angeles chapter of NOMADS the following officers were elected for the current year; president, Elmer Smith, Lane Wells Company; vice president, William McGraw, Western Pipe and Steel Company; secretary, J. V. Robinson, Miller Robinson Company; assistant secretary, C. M. Byron, Baker Oil Tools; treasurer, Fred Tyler, Reed Roller Bit Co.; assistant treasurer, Waldo G. Moore, Cavins Co.; sergeant-at-arms, Hi Cassidy, the McCarty Co.; deputy sergeant-at-arms, Custer Morrow, the Lummus Co.; regents, retiring president Roland E. Smith and Henry W. Pullman, Baker Oil Tools.

AT the annual business meeting of the New York chapter of NOMADS held on January 8 the following officers were elected to serve for the ensuing year: E. H. Trammel, president; W. G. Foster, vice president; R. M. Dinges, secretary; J. W. Reed, assistant secretary; C. R. Tunnell, treasurer; E. R. Carter, assistant treasurer; H. J. McAdams, sergeant-at-arms; G. V. Leece, assistant sergeant-at-arms; W. H. Siems and W. J. Campbell, regents.

Eugene J. Brinkman



R. L. Gollum

E. H. Trammel

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WORLD PETROLEUM ABSTRACTS

Summaries of the Most Important Articles as Published in the Oil Press of the World Dealing with Technical and Economic Aspects of the Petroleum Industry—Edited by Dr. O. W. Willcox.

GEOLOGY

Character and Significance of Oil-field Waters in the Rocky Mountains.—James B. Crawford, in MINES MAGAZINE, Vol. 34 (1944), No. 9, pp. 470-475, 508.

From a large number of analyses of waters from different fields the main facts stand out as follows:

The oil field waters of the Rocky Mountain region are in general much more dilute than oil field waters in other oil-producing areas, suggesting infiltration and dilution by meteoric waters.

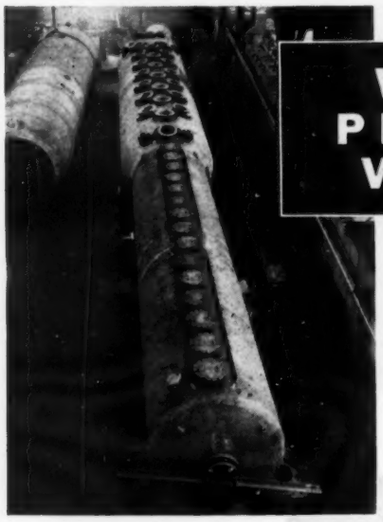
The concentration of dissolved solids of these oil field waters is an index to water movement in the formations, and thus an index to the physical characteristics of the stratum; most waters associated with commercial deposits of oil or gas contain solids of more than 2,000 parts per million.

There are no characteristics in oil field waters of this region that can be used as criteria for distinguishing between waters in marine and nonmarine formations, or for distinguishing waters that are, or have been, in contact with oil.

The oil-field waters of this region are divided into two main types, with one type largely confined to pre-Triassic rocks and the other type to post-Triassic rocks; the oils are similarly divided; this suggests the possibility that there is a relationship between oils and their associated waters in this region.

Contact of oil and water, with or without the influence of bacteria, may have resulted in major changes in the water; similarly, such contact may have resulted in major changes in the water; similarly, such contact may have also resulted in major changes in the oil.

The possibility that in some fields oil has migrated vertically is supported by water analyses.



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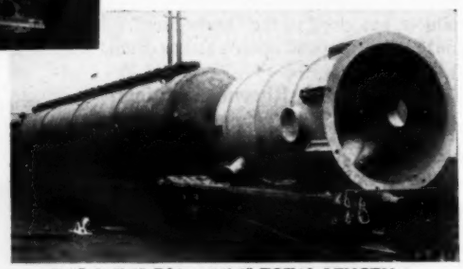

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PHYSICS

Analysis of Decline Curves.—J. J. Arps, in PETROLEUM TECHNOLOGY, Technical Publication No. 1758 (1944) 20 pages.

As is well known, the volume of production of most, if not all, oil wells begins to decline from the moment the oil begins to flow in them, and continues at an ever decreasing rate until no more oil is obtainable under natural conditions of flow. The operator has a large interest in knowing what the volume of production is likely to be at some future time and about when the end is to be expected. The same information is also of great interest for the appraisal of oil properties.

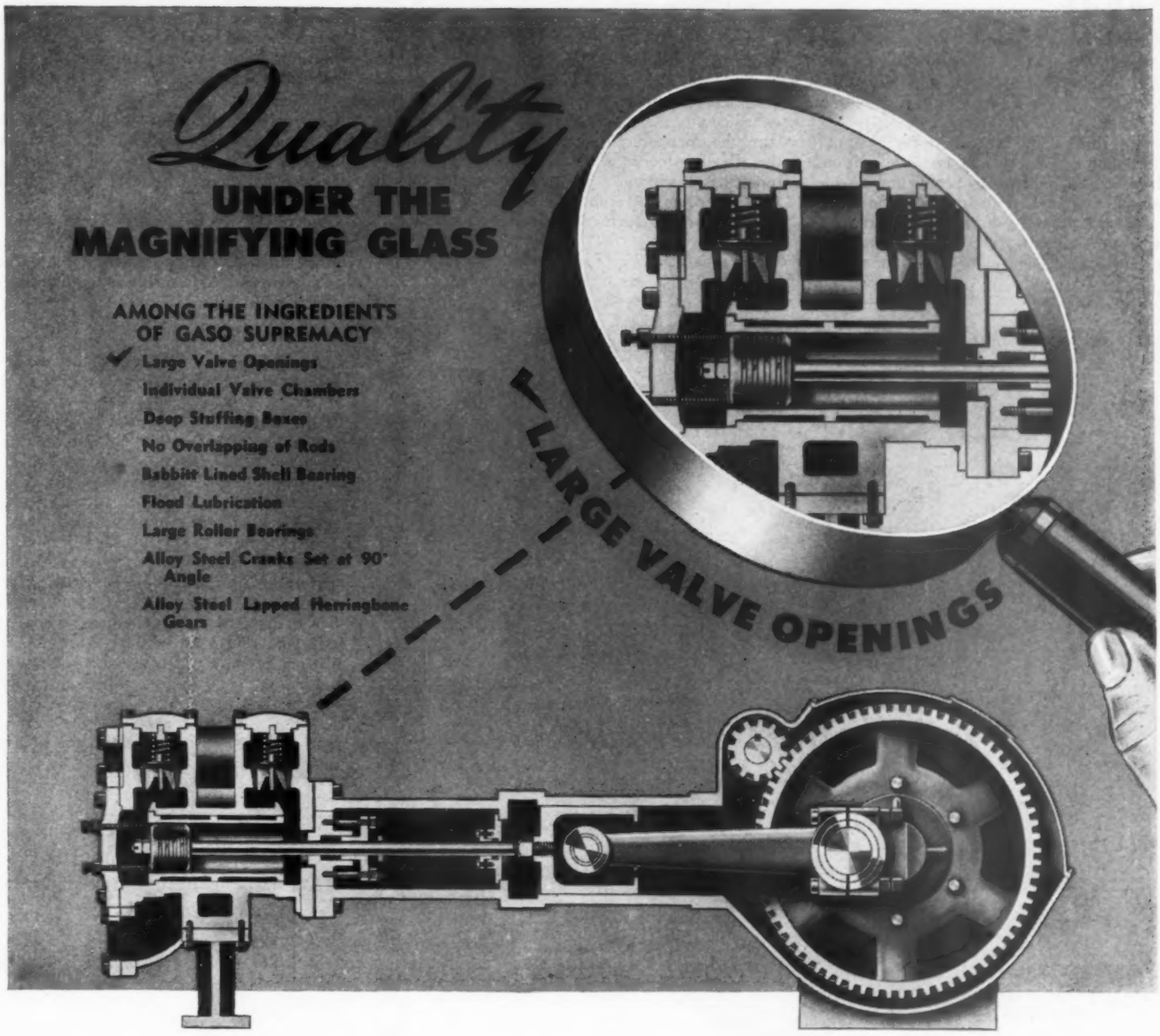
All oil wells do not decline at the same rate, which means that "decline curves" will be different. However, most production decline curves can be classified into a few simple types, which can be recognized by graphical, statistical or mathematical means. There is a distinct interrelationship between these types, and a detailed study has revealed some new characteristics and possibilities for simplification of the extrapolation procedure. Among these, the most important are:

1. A decline calculator to be used for exponential decline curves plotted on semilog paper. This calculator, which is based on the clide-rule principle, makes it possible to read off the monthly decline percentage and the future reserve directly from the original curve.

2. The mathematical relationship between rate-time, rate-cumulative and rate-decline percentage for hyperholic and harmonic decline.

3. A graphical construction method for extrapolation of hyperbolic-type decline curves, plotted on semilog paper. This method is based on the three-point rule, which is a mathematical connection between the production rates of three equidistant points on the curve.

4. The introduction of straight-line decline charts for hyperbolic decline. These charts have vertical scales arranged in such a manner as to make straight lines out of both rate-time and rate-cumulative curves, belonging to the hyperbolic type. Use of these charts facilitates extrapolation of this type of production curves considerably.



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GENERAL

Post War Petroleum Control—William B. Heroy, before POST WAR MINERAL CONTROL SESSION, AMERICAN INSTITUTE MINING & METALLURGICAL ENGINEERS, New York, February, 1944.

Post war international control of petroleum, if instituted, should be such as to assure all nations, even those lacking indigenous petroleum, of adequate supplies of oil for their national development; and also to prevent the accumulation of large stocks by nations that might again assail the world's peace. Depending on circumstances such controls might be exercised on any or all the following lines:

Control of crude petroleum at the source may be exercised by political and economic control of the producing areas. In the case of technically backward countries such control may be made effective through the operation of concessions which would be issued to corporations or associations of corporations advanced in petroleum technology, with due regard to the economic interests and general development of such countries.

Control of overseas transportation of crude petroleum could be made most ecective. A large proportion of the normal international trade in petroleum and its products is water-borne and the routing, destination and cargoes of tankers could be readily administered.

Control of manufacture of petroleum products, both natural and synthetic, in countries whose motives might be regarded with suspicion, could be readily exercised by inspections and checks.

Control of stocks could be exercised through regulation of importations and the checking of inventories. Limitation of the building of stocks to short-term requirements would be particularly effective.

Control of aviation motor fuels, especially of fighting grades, would be potent means of preventing the development of military air forces.

If the three great powers which at present control most of the world's oil resources can agree among themselves as to the manner in which such controls shall be exercised, all the essential elements for the curbing of any future attempted aggression will have been realized.

If however, commercial rivalries and national ambitions are permitted to prevent the establishment of a system of fair administration and distribution of mineral resources, then we shall have no assurance that peace will be more than a period of preparation for future wars. The opportunity lies before the three great Allies to serve as trustees for the world in the preservation of peace, and the control of petroleum resources can be used as a most effective implement to accomplish that end.

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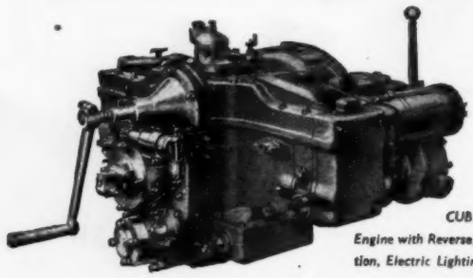

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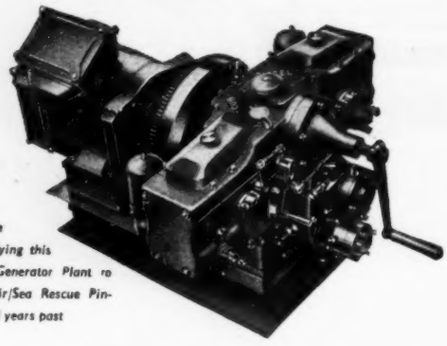

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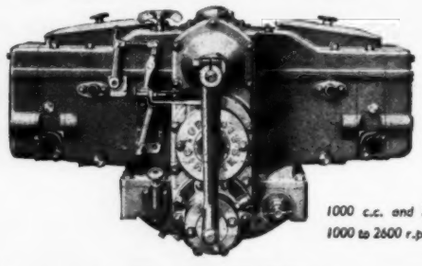

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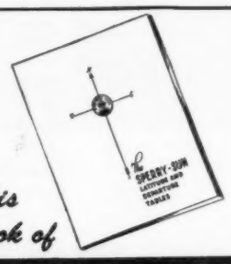

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Rebuilding Far East Plants

IF materials are available, it will require about three years to rehabilitate the refining facilities of the Dutch East Indies, assuming that the Japs follow the same scorched earth policy when they are driven out that the Dutch pursued, and also that American bombing of the now-Jap-held installations continues at the present effective pace. That is the opinion held in authoritative military and trade circles.

Restoring the fields is not expected to present much of a problem, although many of them will probably have to be redrilled. However, the fields for the most part are shallow and can be drilled in a comparatively short time. It is believed that the Japs moved into the islands fully prepared for the destruction they found and brought quantities of equipment and materials with them.

Reports filtering into this country, plus a piecing together of Domei broadcasts picked up, indicate that for the past year oil shipments from the Indies have been dwindling. Last year saw Allied bombers raze the principal refineries at Surabaya, Java; Palembang, Sumatra; and Balikpapan, Borneo. All these plants had previously been scorched by the Dutch in 1942, but presumably the Japs had been able to rebuild. In the last quarter of 1944, Tarakan, in Northern Dutch Borneo, also came into American bombing sights for the first time.

Early in January of this year Tarakan was revisited by bombers, and "eggs" were laid on Halmahera and Miri. On January 6 British naval carriers bombed "most successfully" the Pangkalan Brandan refineries in northeastern Sumatra. This was the site of one of the principal refineries in Sumatra of the Bataafsche Petroleum Maatschappij (Batavian Oil Company, a Royal Dutch Shell affiliate).

Oil companies of the Royal Dutch group are said to have detailed plans all ready for rehabilitation of their properties in the Netherlands East Indies and in the British possessions in the Far East. Crews for the work have been recruited, and it is understood some are now being trained in Australia in preparation for the day when they can move into the islands and start the job. Practically all the material and equipment will have to come from the U.S.

According to a recent Jap broadcast recorded by the Federal Communications Commission, the Jap lines of communications to the Dutch East Indies have suffered so much that they have decided to create a single synthetic oil control company "in order to boost the production of synthetic oil." This will be effected by a merger of the leading oil companies in the field and will be capitalized at 250,000,000 (M) yen. It will act as "the sole controlling organization of synthetic oil enterprise" in Japan and occupied Korea and Manchuria.

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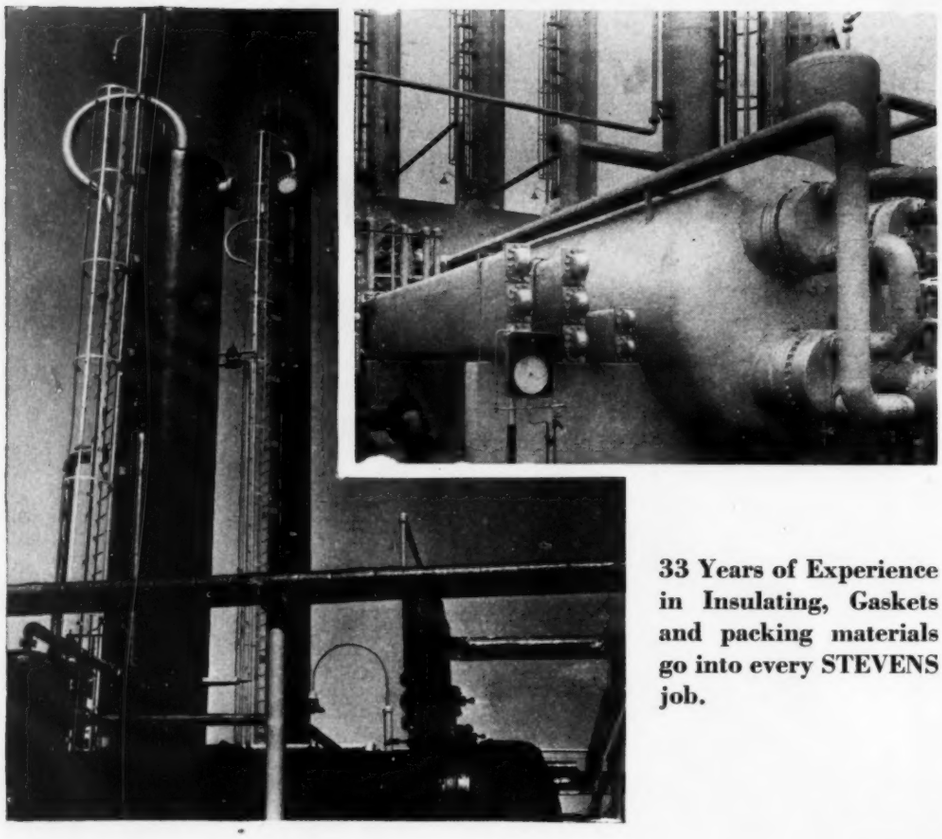

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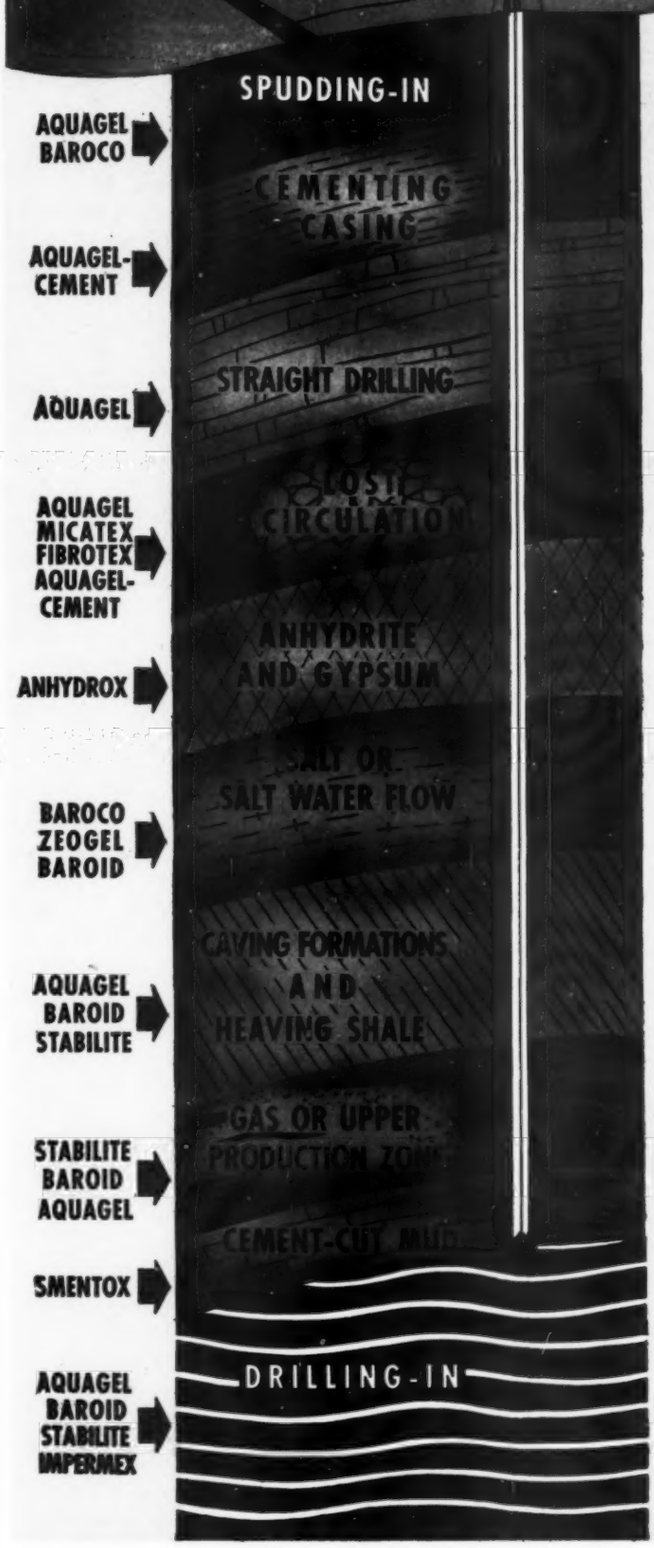

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(*Continued from page* 51)

Seriously speaking, the cars we are going to get immediately after production is resumed—sometime after VE-Day—will be 1942 models altered only to an extent comparable to normal year-to-year changes, and these changes will be chiefly in appearance—new, streamlined fenders; fancy grillwork; and different bumpers. New bearings developed in wartime may be applied, but present WPB restrictions rule out much possibility of major engineering developments, which normally come only every three to five years in any case.

G. H. Cummings has recently summarized the trends which may be expected in postwar Models No. 2, 3, and 4. These include: (1) smaller engines, weighing eventually as little as two pounds per horsepower as compared to the present average of six pounds; (2) less overall weight, somewhere between 2,000 and 2,500 pounds for cars of the type which now weigh 3,000 pounds; (3) improved mileages, up to 30 miles per gallon when engines have been redesigned and cars made lighter; (4) numerous body styling changes, such as curved glass windshields and aerodynamic body designs; (5) rigid body construction; (6) automatic transmissions, expected to be standard equipment as soon as manufacturing costs can be brought down; (7) greater use of plastics, for example, in the framework of front seats, but not for bodies in at least the predictable future; (8) longer wear, resulting from increased industry knowledge of metals and such processes as nitriding; and (9) sealed-in components, such as starters, generators, and (perhaps eventually) whole engines.

Cummings concurs in the belief that future engines will probably be built to use gasolines of 85-90 octane number, but he reports a wide variety of opinion on such changes as fuel injection, air conditioning, rear-engine design, and air-cooled engines.

The automobile industry is said to expect a number of 6,000,000-car-per-year years in the postwar era. It will be more than interesting to see if drastic engineering changes take place during that period.

Turning to the subject of airplanes, almost anyone can set himself up as a prophet with equal justification. All that seems apparent is that peacetime operations will be far below wartime levels, although civilian passenger and freight operations will continue to increase rapidly. There will not be a plane in every garage, however, nor will the immediate postwar air be full of helicopters. The complicated technical economics of the situation are extremely interesting but are far too detailed to discuss here. It must suffice to note that expert concensus has it that 100-octane aviation gasoline demands for the first five postwar years will probably not average over 100,000 barrels per day—less than 20 percent of present output. What the situation will be like ten years from now is anyone's guess. Jet propulsion or its brother, the gas turbine engine, may very well revolutionize fuel demands. Almost any combustible fuel can be used in these engines (with due regard to erosion and corrosion properties, of course), and, if the efficiencies of this type of propulsion can be improved, it would not be too surprising to find kerosenes the aviation fuels of 1960. Then again, high-octane-gasoline, internal combustion engines may continue to be so improved that they may not be greatly displaced. Only the future can tell.

Naturally, gasolines are not going to be the only fuels of the immediate future. Diesel fuels bid fair to occupy an increasingly important place, both because of their innate economies—higher B.t.u. content per gallon, low cost, (at least at present), and more efficient engine cycles—and the great strides in Diesel engine development occasioned by wartime applications. So vast has been the installation of Diesel engines in the Navy's "small boats" that in October, 1943, Navy Diesels went ahead of steam in volume of horsepower produced. An estimated 25,000,000 horsepower of Diesel engines were produced in 1943, an amazing figure when it is considered that the cumulative horsepower of all the Diesels ever manufactured in this country prior to 1942 totaled only some 19,930,000 horsepower. Diesel-powered trains, trucks, buses, ships, and stationary engines were increasing in number prior to—and during—the war, and this trend will certainly continue thereafter. Even though much of the wartime horsepower installed is of an expendable nature, it would seem that postwar demands for Diesel fuels will greatly exceed those of the past. Future quality levels for these fuels are not so clear, but it would appear that a retrograde trend in cetane numbers is not very likely. The supply picture is also clouded, for catalytic cracking plants prefer much the same distillate stocks for gasoline manufacture as are required for premium Diesel fuels. How these problems are resolved should be interesting to observe—and important to industry.

Kerosene, incidentally, is still an important heating agent and illuminant. The future for it and the other "distillate" fuels is closely related to that for the Diesel oils.

The heavy fuel oil problem is also quite complex. These fuels are the only petroleum products which are sold at a lower price than their volumetric share of the cost of crude oil. This net loss has occasioned much attention, and it is likely that an increasing quantity of postwar residual fuel oils will be converted into gasoline by various methods. Only a few users will be unable to shift to other fuels when and if this procedure causes an increase in prices and a diminution in supplies, for it is estimated that only about 25 percent of the heavy fuel oil demand could not be met by coal. Postwar forecasts reflect the confusion among petroleum economists as to the exact effects of these and other factors, some forecasters predicting a rise in demand while others prophesy a decrease.

The postwar use of natural gas is at present the subject of heated controversy, soon to be brought to a head at hearings conducted by the Federal Power Commission. Certain parties interested in strict conservation have joined forces with sectional interests who would like to reserve natural gas supplies for future use in the states in which they are found, and this combine, strongly aided by coal and manufactured gas interests (who do not care for competition with cheap natural gas), is fighting both nationally and in such states as Texas and Louisiana for restrictions on the interstate shipment of natural gas and for accompanying legislation to ban its use for certain purposes such as boiler fuel. On the opposite side of the fence are the owners of huge fields which would be of little value for many years if such restrictions are imposed; companies operating gas pipelines to regions in which natural gas supplies are depleted or nonexistant; companies planning new pipelines; and the increasingly large number of household and industrial users who are naturally interested in paying as little as possible for their gaseous fuels.

It is far too early to predict the outcome of this argument. If prewar trends should be allowed to continue, the network of gas pipelines will be expanded and will carry natural gas into "unexplored" regions. Unorthodox tankers carrying liquefied natural gas may ply the waters between the Gulf Coast and the Northeastern Seaboard. In any case, it is likely that restrictive measures will be imposed which will rigidly prohibit the waste of natural gas even where this gas cannot be conveniently used, stored, or formations repressured. If these measures are as harsh as some would desire, they will constitute a "back-door" entry into government control of the petroleum industry, since natural gas is becoming an increasingly important and inseparable coproduct of that field.

Little need be said regarding the other fuels: coal, the manufactured gases, wood, and so forth. The uses of coal, for example, are certain to multiply as other fuels become scarce or more expensive. Supplies are semi-inexhaustible, as mentioned. This trend toward increased use will probably be a gradual one.

* * * * * * * *

We have thus taken a fleeting glance at the "fuels of the future." This glance has revealed that the way is beset with so many interlocked problems and factors that no sharply defined facts are evident, but it has also given us an indication of some of the issues which may be expected to play their parts. It would seem that the immediate postwar future, as regards the consumer, will not be so very different from the past. Our grandchildren and their descendants, however, may find that their avail-

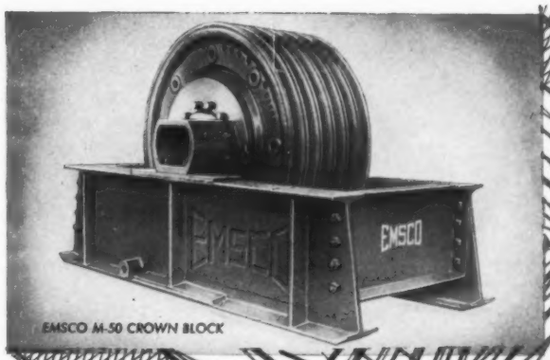
(*Continued on page* 82)

Capacity for the deepest hole

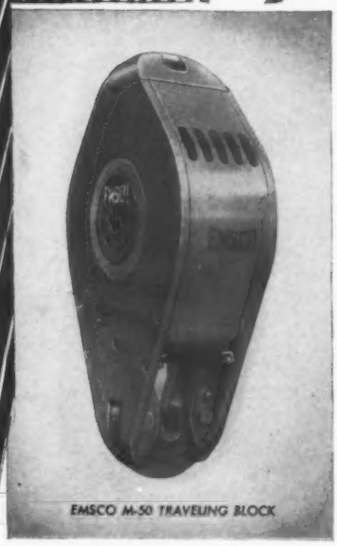
YET EASY TO REEVE, HANDLE, AND TRANSPORT

Emsco Crown and Traveling Blocks overcome the inherent problems caused by the trend toward deeper drilling. Deeper drilling has called for blocks with larger sheaves, wider sheave bearings to give more carrying capacity and greater stability. It has meant wider and longer blocks which slow down operations, restrict pipe racking space, and make it impossible to utilize the full height of the derrick.

Emsco Crown and Traveling Blocks eliminate these problems yet retain all of the features essential in deep drilling. On each sheave are double row Timken tapered roller bearings or patented oversized bearings with specially built bearing races, which take care of end thrust, thus eliminating thrust washers and materially cutting down the width of the blocks. Narrowing the blocks permits a shorter center pin supporting the inner races of the bearings, resulting in increased capacity. The sheave and bearing assemblies are interchangeable between the crown and traveling blocks, and the sheaves are accurately balanced and are spaced close together to prevent the wire line from fouling. The dropping speed of an empty Emsco Traveling Block is faster than blocks of conventional design even though they have a substantial savings in weight due to their compact construction. Streamlined to eliminate projections causing hang up, compact for easy handling and shipment, Emsco Crown and Traveling Blocks are made in five sizes to meet all drilling conditions and requirements.



EMSCO M-50 CROWN BLOCK



EMSCO M-50 TRAVELING BLOCK

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Pullman Acquires Kellogg Company

LATE in December announcement was made that Pullman Inc. had acquired the entire outstanding stock of the M. W. Kellogg Company. The statement, made jointly by D. A. Crawford, president of Pullman and M. W. Kellogg, president of Kellogg Company, explained that the latter company would be operated as a separately incorporated member of the Pullman group, with its present staff of officers and employees, and continuing to specialize as heretofore in research, manufacturing and engineering construction. Mr. Kellogg has been elected a member of the Pullman board.

While preparing to comply with a court decision directing it to dispose of the sleeping car business with which it has been identified throughout its history the Pullman Company has been planning to expand its manufacturing and construction activities.

"By acquisition of the Kellogg Company," it is explained, "the Pullman group will participate in more diversified lines of engineer-contracting, research and manufacturing activities than heretofore, and it is expected that advantageous results will be effected. From the point of view of the Kellogg Company, the change is expected to open new opportunities for service to the oil refining and other industries through substantially expanded facilities made possible by increased resources. It also carries the prospect of expansion into other fields where these enlarged facilities may be applied".

ECONOMIC FACTORS

(*Continued from page* 74)

able fuels have wrought for them a civilization markedly different from ours. Whether the change will be retrograde—merely a struggle to replace diminishing supplies of natural fuels —or progressive—one in which superior fuels, abundantly and cheaply available, have aided in events, will depend upon our technical efforts and those of generations to come, aided and abetted—and not hamstrung—by government influence and attention. It is not safe to say that no fears for the future need be felt; it is better by far to take cognizance of the evident trends and to plan today to avoid trouble tomorrow.

Our fuels of the past have given American industry an edge over the less industrialized nations of the world. If we are to maintain that edge, we must assure ourselves of a continued supply of inexpensive fuels. If we must ever again fight another war—Heaven forbid—we must see to it that no destructive shortages can develop. If we are to again enjoy the peacetime blessings of modern civilization and desire these for our descendants, we must plan wisely now as regards the "fuels of the future."

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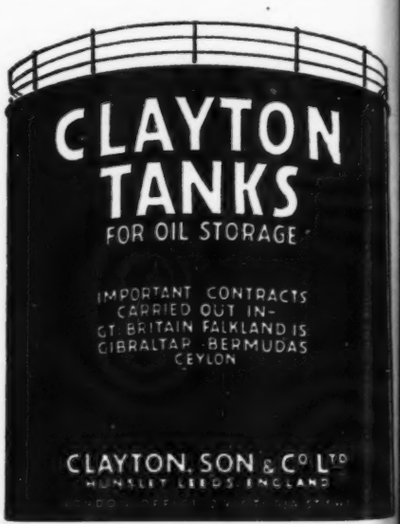
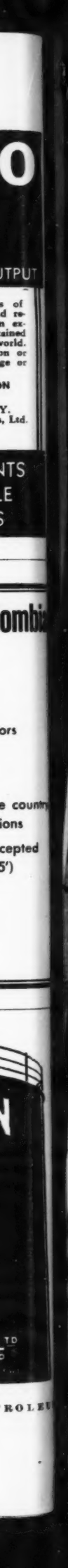
Oil Property Map of Colombia

Scale: 1 to 1,000,000
Showing in Color

1. Concessions in force of major operators
2. Private oil properties, with firm title
3. Concessions tested and surrendered
4. Location of all wildcats drilled in the country depths, oilfields; pipelines and stations
5. Concession applications officially accepted Measures 1.80 x 1.05 meters (6' x 3.5')

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